Saving behaviour of British households

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Award date:
2007

Awarding institution:
University of Bath

SAVING BEHAVIOUR OF BRITISH HOUSEHOLDS

by

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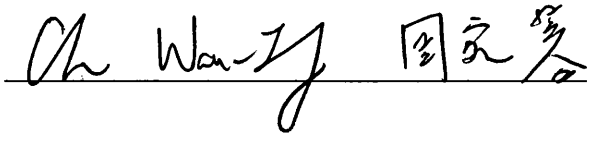
A thesis submitted for the degree of
Doctor of Philosophy

University of Bath
Department of Economics and International Development

December 2007



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ABSTRACT

Using the data from the British Household Panel Survey (BHPS), this thesis studies British households' saving behaviour taking into account the concept of inconsistent time preference. The concept of inconsistent time preference suggests that households' time preferences are hyperbolic, and such households appear averse to saving for the short term and favour saving for the long term.

This thesis is set out based on two theoretical models: one is the buffer-stock model and the other is the quasi-hyperbolic life-cycle consumption model. The buffer-stock model under a life-cycle/permanent income hypothesis posits that households make precautionary savings to buffer income uncertainty in the next period, and this is known as precautionary saving behaviour. Based on the same theoretical specifications, the quasi-hyperbolic life-cycle consumption model distinguishes itself from the previous model by assuming that households' time preferences are qualitatively hyperbolic. As a consequence, one theoretical anomaly emerges: precautionary saving effect may be found missing for a household with a hyperbolic discount function. Econometric estimation methods are employed to carry out three empirical studies to examine the determinants of households' short-term saving behaviour and long-term saving behaviour respectively. In the empirical framework, the anomaly mentioned previously is investigated. Moreover, the theoretical implications of the quasi-hyperbolic consumption model are examined.

In general, the empirical findings of this study suggest that British households' saving behaviour can be explained by the quasi-hyperbolic consumption model. First of all, the precautionary saving effect is found to be missing. Secondly, those households who possess illiquid wealth tend to save less for unexpected events in the short term and prefer to save for the long term, and this is consistent with the pattern that hyperbolic households would exhibit. Thirdly, households' long-term savings-age profiles over the life cycle exhibit life-cycle effects, whereas their short-term savings profiles remain constant throughout the young and middle age groups.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to a number of people without whose contributions this work would not have been accomplished.

I greatly appreciate my supervisor, Dr. Joshy Easaw, for his support and guidance which contributed enormously to the development of this work.

I would like to deliver my appreciation to Professor Lonnie Magee in Department of Economics, McMaster University, Canada, for sharing the programming code of the nonparametric kernel-smoothed conditional quantile estimation method which was applied in this study.

I would like to give special thanks to: Dr. Peiju (Lucy) Ting, Dr. Jinhuai (Jerry) Lin, Ms. Hester Kan, Ms. Huijong Chong, Dr. Yun-jung Kim, Dr. Ramon Arigoni Ortiz, and Dr. Youngjun Choi, for their dear friendship through constant support and encouragement during these years of study.

I would like to express millions of thanks to my parents, Mr. Tsai-Kuei Chou (周財貴先生) and Ms. Li-Chin Hu (胡麗卿女士), who always love me, believe me, support me, and always be there for me.

獻給我的父母

To my parents

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CHAPTER 1 : INTRODUCTION

1.1 BACKGROUND

In modern microeconomics, saving behaviour is about the decisions that households make to retain income to finance future consumption as opposed to spending money now, for some specific purpose, or for some general unspecified contingency in the future; the basis for a theory of consumption is therefore the theory of intertemporal choices (Deaton, 1992). Since the 1950s, the *Life Cycle Hypothesis*[1] (LCH)/*Permanent Income Hypothesis*[2] (PIH), hereafter the life-cycle model, has become a widely applied theoretical framework to explain households' intertemporal consumption/saving allocations over the life span at the individual and household level. In this framework, consumers, subject to budget constraint, strive to maintain the smoothest consumption path that they can achieve over their life span, in order to maximize the utility of consumption. As a consequence, saving is important.

Theoretically, in the standard life-cycle framework where an economic agent is assumed to be perfectly foresighted and rational, intertemporal time preference is assumed to be constant over time. Time preferences are captured mathematically in a discount function; an exponential discount function is generally used in the standard life-cycle model to describe the weights placed on utilities received at different points in time.

By contrast, research on the inconsistency of time preference has been growing widespread, and to date literature on related investigations has largely come from experimental psychologists and experimental economists. The most frequently documented texts are characterised by positing the existence of a *hyperbolic discount function*, which argues that the spontaneous preferences of both human and non-human subjects take the form of a hyperbolic curve, rather than the conventional 'exponential' curve that would be produced by consistent choice over time (Ainslie, 1974; Green, Fry, and Myerson, 1994; Kirby, 1997). It delivers the reversal of preference: when offered the choice between £50 now and £100 a year later, many people will choose the

[1] It was developed by the economists Irving Fisher (1867-1947), Roy Harrod (1900-1978), Alberto Ando (1929-2001), and Franco Modigliani (1918-2003).
[2] It was proposed by Friedman (1957).

immediate £50. However, given the choice between £50 in five years and £100 in six years, almost everyone will choose £100 in six years. A rational economic agent would have consistent choice: £100 a year later as well as £100 in six years. David Laibson, in the late 1990s, formalised the quality of the hyperbolic discount function in a life-cycle consumption model[3], namely hereafter the quasi-hyperbolic life-cycle consumption model, in order to explain consumers' consumption/saving behaviour.

Motives for making saving have been integrated in a standard LCH/PIH framework to explain consumers' saving behaviour, such as saving for retirement, saving for the next generation, precautionary saving, etc. The formation of the buffer-stock model, in early 1990s, aimed to explain consumers' precautionary saving behaviour when they are faced with income risk. Since then, the significance of a precautionary saving motive in consumers' saving behaviour has caught a lot of research attention, and many related empirical investigations have been undertaken as a consequence. However, the quasi-hyperbolic life-cycle consumption model, which introduces the hyperbolic discount function to a buffer-stock model, has obtained an anomalous insight regarding precautionary saving behaviour.

The quasi-hyperbolic consumption model suggests that hyperbolic consumers take up external commitment mechanisms to preserve savings for the long-term future by holding them in illiquid forms. In addition, addressing the problem of inconsistent time preference, a behavioural life-cycle model (Thaler and Shefrin, 1981; Shefrin and Thaler, 1988) brings in the concept of *mental accounting* as an internal commitment mechanism. The main insight of mental accounting suggests that distinguishing the purposes for saving or the time in which the money will be used, has significant impacts on saving behaviour. The assumption that the asset is fungible does not hold in this model. In general, the operations of both hyperbolic discount function and mental accounting takes place in the process of making a saving decision, and are at work in consumers' minds: this is often called the 'black box'. To illustrate this, Wärneryd (1999) summarised in a diagram[4] how these psychological factors perform in an economic consumption/saving model.

[3] More precisely, Laibson incorporated the feature of hyperbolic discount function with the buffer-stock model.
[4] Note that this does not stand out as a theoretical model.

Section 1.2 addresses the development of time preference which is assumed to be exogenous in a standard LCH/PIH model, and this is followed by a discussion on saving motives in such a model. Section 1.3 presents some of the contributions of psychology to economics, namely, inconsistent time preference, mental accounting, and psychological perceptions. Section 1.4 sets out the main contributions, objectives, and outlines of this study.

1.2 THE STANDARD LIFE-CYCLE/PERMANENT INCOME HYPOTHESIS (LCH/PIH)

1.2.1 Development of time preference

As assumed in conventional economics, the concept of *time preference* states that a consumer favours enjoyment nearer in time to distant enjoyment: a consumer with high time preference wants to spend money now and possesses a high discount rate on the future, whereas a consumer with low time preference has a low discount rate and wants to save.

Samuelson (1937) introduced a generalised model of intertemporal choices that was applicable to multiple time periods, called the discount-utility (DU) model. In this model, a discount rate was generated to play the role of the intertemporal time preference, which was viewed as a mixture of the effects of various saving motives that are mentioned below. The discussions that culminated in the formation of this model originated in the mid-nineteenth century. In his publication *The Sociological Theory of Capital* in 1834 (1905), John Rae discussed the sociological and psychological determinants of intertemporal choices in explaining the differences in national wealth levels between nations. In Rae's view, intertemporal choices, reflecting time preference, were the joint product of factors[5] (motives) that affected 'the effective desire of accumulation'- a psychological factor that determined a society's level of saving and

[5] Rae introduced four factors: the two factors that promoted the effective desire – the bequest motive and the propensity to exercise self-restraint, and the two factors that limited the effective desire - the uncertainty of human life and the excitement produced by immediate consumption and the following discomfort of deferring such gratification. (Frederick, Loewenstein, and O'Donoghue, 2002)

investment. Drawing upon Rae's views, Jevons (1888), Jevons (1905), and Senior (1836) also contributed to the development of the concept of intertemporal choices. Later, Böhm-Bawerk (1889) (1970) began modelling intertemporal choices as decisions about allocating resources over different points in time, and this was formalised by Irving Fisher (1930). Fisher plotted the intertemporal consumption decision on a two-good indifference diagram between two periods. He stated that the pure time preference could be interpreted as the marginal rate of substitution between present and future consumption, which was equal, in equilibrium, to the relative price of present and future consumption (Fisher, 1930). Both Böhm-Bawerk and Fisher considered a list of psychological factors that had impacts on a consumer's time preference.

However, Samuelson (1937) condensed various psychological factors (motives) into a single rate of time preference in the DU model, and the discount factor was considered to be constant over time. This assumed that a consumer would make identical decisions at any point in time. Since then, a standard intertemporal choices model has carried two standard assumptions: one is that a consumer's time preference is positive[6] and consistent[7] over the life span, and the other is that marginal utility is diminishing, which motivates a person to spread consumption over time. These are embedded in a standard life-cycle model.

1.2.2 Savings motives

As discussed earlier, it has been widely suggested that a person's intertemporal choices involve a variety of determinants, both objective and personal. With his *The Theory of Interest*, Fisher (1930) based his explanation of a consumer's personal savings on five motives: foresight, self-control, habits, expectation of life, and love for posterity, and all these factors had impacts on intertemporal choices.

In a series of articles in the 1950s and 1960s, Franco Modigliani, Richard Brumberg and Albert Ando asked why people save, under the life-cycle hypothesis (LCH) (Modigliani and Brumberg, 1954). Accordingly, a multiple-period life-cycle model posits that

[6] Positive time preference motivates a person to concentrate consumption in the present.
[7] Consistent time preference indicates that it should not change with the calendar date from which the periods are viewed

consumers, who are defined as perfectly foresighted and prudent, choose when to spend their lifetime resources according to their *needs* and *tastes*[8], i.e., endeavouring to optimize his/her utility according to budget constraints. This indicates that saving decisions in this model are considered to be goal-directed, i.e. saving for bequeathing to heirs[9], saving for holidays, saving for retirement, etc. However, it has been noted that the standard life-cycle hypothesis does not deal well with what will happen if incomes fluctuate erratically over time, whereas precautionary saving motive - consumers save according to their expectation of future uncertainty (risk) - is embedded in the permanent income hypothesis (PIH) proposed by Friedman's (1957). In empirical investigations on saving behaviour, it has become a common practice to take into account determinants from both the life-cycle hypothesis and the permanent income hypothesis, and the two terminologies are usually used interchangeably[10], as in both hypotheses, consumers are assumed to form intertemporal choices to maximise their utility over a smooth path throughout their life span.

Since the late 1980s, Zeldes (1989), Deaton (1991), and Carroll (1997)[11], in particular, have considered precautionary saving behaviour as playing an important role in understanding people's saving behaviour over the life span at both the micro-unit and aggregate levels. The strongest claim in support of the precautionary motive came from the work of Carroll (1992, 1997) - the buffer-stock model. With LCH/PIH underlying it, an assumption in the buffer-stock model is that consumers are sufficiently *impatient* in the case that, when income is certain, they would like to borrow against future income. On the other hand, consumers are also *prudent*, in Kimball's (1990) sense that they have a precautionary saving motive, in order to accumulate wealth to buffer against income uncertainty. This model delivers an insight that consumers with higher income risk in the (near-term) future, tend to save more. The existence of a precautionary saving motive and its influence has been investigated widely in many countries at the microeconomic level.

[8] This refers to variables that affect the desirability of consumption at different points in the life cycle, household demographic structure being perhaps the most obvious. (Deaton, 1992)
[9] Hurd (1990) is a major modification of the LCH as it added a bequest motive to a standard LCH.
[10] This is especially whilst permanent income is defined as the annuity value of current financial and human wealth.
[11] This work emerged firstly in 1992 as a mimeo and was published as a journal paper in 1997.

To sum up, a consumption model under a LCH/PIH has mainly paid attention to investigating the influence on saving motives for a consumer's intertemporal saving decisions, when the rate of time preference is assumed to be constant and positive over time.

1.3 BEYOND THE STANDARD LCH/PIH

1.3.1 Inconsistent time preference

One of the DU model's anomalies[12] suggested by empirical observations is *hyperbolic discounting*: it has been found by experimental psychologists that people's time preference is dynamically time inconsistent and is depicted by hyperbolas. In brief, the time discount rate with the future is decreasing as the time point is getting further from the present, indicating that discount rates are dynamic over time.

In the domain of Economics, it can be dated back to Strotz (1955) where the idea of inconsistent time preference was first proposed. He suggested that, due to the lack of self control, a consumer in the future self would not be able to carry out the optimal plans which were made by the early self; as a consequence, a consumer would need pre-commitment mechanisms to make sure that the optimal decisions were carried out. Later, the concept of inconsistent time preference and the self-control problem was formalised by behavioural economists. The quasi-hyperbolic life-cycle model proposed by Laibson (1997, 1998) incorporates hyperbolic discount function with a life-cycle model. This model illustrates that whilst making intertemporal choices to optimise his/her aggregate consumption utility subject to a budget constraint, consumers are assumed to have dynamic inconsistent time preference, and their decisions are dependent on the length of time horizon of their perspectives from the current time point: a high discount rate on a decision in the short term and a low one regarding a long-term decision. Moreover, this model proposes that these consumers would prefer saving for the long term to for the short term.

[12] Other anomalies include 'the sign effect' - Gains are discounted more than losses, 'the magnitude effect' - Small outcomes are discounted more than large outcomes, 'the delay-speedup asymmetry', 'the preference for improving sequences', and 'the violations of independence and preference for spread.' See Frederick, Loewenstein, and O'Donoghue (2002) for a detailed review.

1.3.2 Nonfungibility of savings

In a standard life-cycle model, money is assumed to be fungible as there is presumably a perfect capital market where consumers can lend and borrow freely. Even though savings are goals-directed in a conventional life-cycle model, a dollar of money saved can serve more than one purpose and therefore savings (accumulated wealth) as a whole are treated as an aggregate unit and fungible.

By contrast, Shefrin and Thaler (1988) developed a behavioural life-cycle model and employed the concept of *mental accounting,* as the internal controlling strategies that a household applies to cope with its consumption-savings decisions. The idea of mental accounting suggests that a consumer has a mindset that assigns resources to various accounts, and these accounts have a different marginal propensity to consume. This implies nonfungibility. The quasi-hyperbolic life-cycle consumption model (Laibson, 1997, 1998) also suggests that consumers prefer putting money away for long-term purposes in illiquid forms than in liquid ones. This theory also suggests the nonfungibility of a consumer's total savings.

1.3.3 Psychology in a life-cycle model

Both of the aforementioned concepts of inconsistent time preference and mental accounting incorporate psychological factors into the conventional economic models. In his essay about Behavioural Economics, Katona (1980) proposed that subjective human factors loom large in economic activities, such as the motives, attitudes, and expectations that influence decisions in economic matters. In *The Psychology of Saving*, Wärneryd (1999) summarised a number of psychological issues regarding saving behaviour, and presented a schema (this is NOT a theoretical framework), which is shown in Figure 1-1, and explains how one can accommodate psychological variables into a life-cycle model. The purposes (motives) of savings addressed in the LCH/PIH consumption model can also be seen as being located in 'future needs' and 'control of expenditure' in this diagram. As specified, the concepts of future needs in this schema are psychological; that is, the psychological perception relates to the uncertainties of household or individual goals, the attainment of which can be threatened in the future, for instance, the attainment of the future need of security is affected by a variety of

sources of risk/uncertainty, corresponding to the precautionary motive. Whilst the four goals of future needs may operate together, a time dimension[13] can be added to their perception of future needs, which simultaneously integrates the influence of time preferences. As can be seen, the influences of saving motives and time preferences work jointly, leading to a *saving act*, thus it would be impossible to disentangle the influence of a pure time preference from all other influences (Loewenstein, 1987; Benzion, Rapoport, and Yagil, 1989). Eventually, it is also suggested that the effect of mental accounting can be observed in a *saving act* as a consumer chooses to put money in a bank account or a private pension scheme.

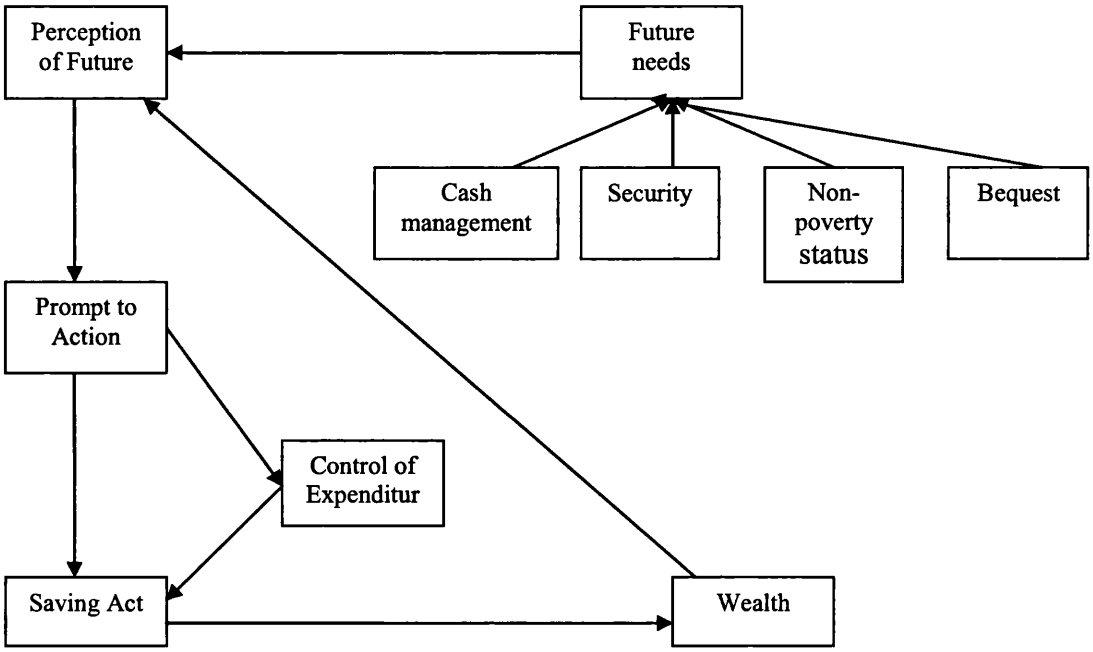

Figure 1-1: A Psychological Schema for the Study of Saving Behaviour (Wärneryd, 1999, p322)

1.4 ABOUT THIS STUDY

1.4.1 Background

One main intuition which underpins this study is from an implication in Behavioural Economics, which suggests that a consumer's time preference is hyperbolic and is

[13] The time horizon varies for different persons and may for the same person vary for the different needs. (Wärneryd, 1999)

dynamically time-inconsistent. When this is applied to people's saving behaviour, it is suggested that consumers have a higher time preference with giving up £1 now for a short-term future, than with giving up £1 for a long-term future. This indicates a higher time discount rate on saving for the short term and a lower time discount rate on saving for the long term, leading to inconsistent saving behaviour regarding lengths of time horizons. For instance, consumers' intertemporal saving behaviour of a long-term planning horizon carries a lower time preference than that of a short-term one, and more savings will be made for the long term than for the short term[14]. Moreover, saving for the long term may be preferred than for the short term.

Precautionary saving behaviour has become a prevalent research topic in the past decade, and the buffer-stock model is the most well-established theory that addresses consumers' precautionary saving behaviour. It suggests that people, being both impatient and prudent, make precautionary savings to buffer income uncertainty in the (short-term) future. Whilst the buffer-stock model assumes that a consumer's time discount rate is consistent over time, i.e. exhibiting an exponential discount function, a quasi-hyperbolic life-cycle consumption model that integrates the quality of a hyperbolic discount function into a buffer-stock framework, suggests some anomalies. One of them is that the precautionary saving effect may be found to be missing for a consumer with a hyperbolic discount function, and consumers' high discount rate (high impatience) with saving for the short term is suggested to be the cause.

It thus becomes essential to investigate this anomaly by using empirical analysis, and moreover, to explore the determinants of households' saving behaviour with inconsistent time preference being taken into account.

1.4.2 Contributions

The application of time preference into saving motives

Conventional studies of saving behaviour paid more attention to observed wealth accumulation and less to consumers' perceived attitudes or motivations in the decision-making process, and this is partly because it was difficult to have knowledge about

[14] The level of savings made can be considered as an indicator for their time preference: high savings made refers to low time preference and vice versa.

people's attitudes, unless they were explicitly stated. It has been raised that heterogeneity of saving motives needs to be taken into account when one studies saving behaviour. As a consequence, this study has the advantage in that it directly looks at consumers' saving motives of a long-term horizon and of a short-term one, as well as the amount of savings made in response to such saving motives. Such saving motives are considered to reflect households' subjectively perceived preferences with saving for different time in the future, and the amount of savings made regarding such motives indicate the degree to which households have managed to give up current consumption for the future.

The application of subjective perceived aggregate risk

Uncertainty about future income and uncertainty about subjective life expectancy are crucial concepts in discussions of the LCH/PIH; for instance, precautionary saving behaviour theory posits that households make savings to buffer against all sorts of risk/uncertainty, in particularly that related to future household income[15]. Related empirical literature will be reviewed in chapter two.

The concept of *risk* should used in situations or outcomes to which probabilities can be attached and in principle at least can be insured against, and the concept of *uncertainty* refers to outcomes where there are no probabilities or even any limited interval of probabilities (Knight, 1921; Luce and Raiffa, 1990). In the literature of precautionary saving behaviour, the concept of *risk* is more widely applied in that probability evaluations of risk/uncertainty are often observed. Nevertheless, these two concepts are not always kept strictly apart, in addition, a certain type of consequence may be perceived as uncertainty by one person and as risk by another; for instance, mortality may be considered as an uncertainty for the young but a risk for the elderly.

In a classic decision making theory, risk/uncertainty is most commonly conceived as reflecting variation in the distribution of possible outcomes, their likelihoods and their subjective values, and this has always been the main practice in economics. In the literature on precautionary saving behaviour, measurement of risk/uncertainty in the early stages was largely obtained by a relatively objective evaluation – taking the means

[15] The buffer-stock model specifies the future of a short-term perspective.

and the variances of the aggregate income/consumption distribution or income realisation from panel data. Gradually, subjectively estimated uncertainty/risk has become widely applied, subject to the availability of appropriate datasets[16]: individuals were asked about the likelihood of being unemployed in the next year; moreover, individuals were asked about their income expectations, about the percentage change if the individuals responded to expect a change, about being unemployed, etc. They were also asked to give a scale of possibility for scenarios of expectation, which concerned their level of certainty of these being fulfilled. However, the accountability of such information may be undermined by the possibility that respondents find it a very difficult task to manage, or by the situation that respondents may not think probabilistically about uncertain events. (Ellsberg, 1961; Zimmer, 1983, 1984; Dominitz and Manski, 1997)

There are various sources of risk that individuals perceive themselves to face; however, it is very uncommon to find in any survey that information about an individual's risk of different facets of their lives has been comprehensively collected. This makes it more difficult to estimate an overall indication of individual's risk. In accordance with Wärneryd (1999), the concept of subjectively perceived risk is adopted to indicate households' perception that their future needs/goals would be under threat, which is a more psychologically driven approach. Stone and Winter (1987) have defined risk as *a subjectively-determined expectation of loss*; the more certain one is about the expectation, the more risk he/she has. This idea has been widely applied in the field of consumer behaviour, and only the recent studies are named here (Lim, 2003; Cunningham, Gerlach, Harper, and Young, 2005).

This work applies a household's general evaluation about its financial situation in the next 12 months as an indicator for its aggregate perceived risk. Those who expect deterioration in their financial situation are considered to be more certain about a risk, than those who expect improvement or those who expect things to remain unchanged. This posits that these households make saving decisions based on their subjective

[16] For instance, the VSB Panel project at CentER, Tilburg Univeristy. The VSB Panel project is known as the Dutch household survey - CentER Panel Survey (CPS), and this survey started in 1993. The information in the data set can be divided into seven categories: household characteristics, accommodation, labour-market status, pension entitlements, health, income, assets and liabilities, and economic and psychological aspects of financial behaviour.

evaluations about every facet of their lives, including not only income uncertainty but also health and other risks.

The application of effects of habit

Katona (1975) noted that most behaviour is routine behaviour. In psychology, habit implies a tendency towards routine and repetitive behaviour; several interpretations can be applied on continued habits in saving behaviour. First, in a doer-player behavioural model, doers may apply habitual rules to control players' impulsive actions; for example, households join Christmas clubs or apply internal rules of thumb to save money regularly (Thaler and Shefrin, 1981; Shefrin and Thaler, 1988). Secondly, it may well be that there are habitual restrictions on consumption (Marshall, [1890] 1990; Wärneryd, 1999), suggesting that if people were brought up to control their means, they are most likely to keep to this pattern. Thirdly, people prefer things to stay the same, and thus it causes discomfort to break a well-established habit, and this refers to a cognitive bias - status quo bias (Kahneman, Knetsch, and Thaler, 1991), e.g. endowment effects (Thaler, 1980) and loss aversion (Kahneman and Tversky, 1979; Thaler and Benartzi, 2004). In this study, habit effects on households' saving ratio regarding long-term and short-term purposes, will be investigated. Households who report to save primarily *'for no specific reason'* are considered to practice saving as a result of habit (Wärneryd, 1999).

Objectives

- To explore households' savings behaviour of a long-term planning horizon and those of a short-term planning horizon, respectively, by using the data from the British Household Panel Survey. The research frameworks in this work aim to investigate the determinants of saving motives and savings per se for two time preferences.
- Precautionary saving behaviour, from a short-term perspective, will be explored through the hypothetical relationships between households' inclination to save for the short term and their perceiving higher risk, as well as between households' short-term saving ratio and their perceived risk.
- Moreover, this work examines the extent to which the ownership of housing wealth and the enrolment in private pension schemes influence households' saving behaviour with respect to different time preferences. Households' holding of housing wealth indicates that they choose to accumulate wealth in illiquid forms, and their

paying into a private pension scheme underlines the fact that they have committed themselves to an external mechanism, in order to save for retirement. Imposing illiquidity on wealth and commitment to making savings characterise some of the approaches which hyperbolic consumers would utilise, in order to keep themselves from splurging and to manage their saving.

- The impact of habit effects on saving behaviour (saving ratios), for the two different time preferences, will be examined.
- Age effects on saving behaviour will be explored by analysing households' long-term savings-age profile and short-term savings-age profile, over the working life cycle.

Outline

Chapter two contains a literature review. Section 2.2 presents the theoretical framework and implications of the buffer-stock model. In addition, it includes the theoretical framework of the quasi-hyperbolic life-cycle consumption model and its implications and related discussions. The theoretical anomaly between these two models will be shown. Lastly the theoretical implications of savings-age profile throughout a life cycle from these two models are discussed. Section 2.3 reviews the related empirical issues of the buffer-stock model and the quasi-hyperbolic consumption model. Section 2.4 concludes this chapter.

Chapter three discusses issues concerning the data and the sample selection. To begin with, the constructions of the dependent variables subject to the content of the survey questions, which are saving motives in the first stage, saving ratio in the second stage, and savings amount in the third stage, are illustrated in detail. In addition, the construction of explanatory variables is also explained and related theoretical and empirical justifications are presented. Next, descriptions of samples are provided. A whole sample is selected from waves 10~13 of the British Household Panel Survey (BHPS), and the sample is disaggregated into two subgroups - homeowners and private pension participants - for the first and the second empirical studies, and into five groups in the third empirical study - males, females, homeowners, private pension participants, and employees. The separation between males and females considers the influence of gender difference. Putting homeowners and private pension participants into comparison shows the effects of two distinct external commitment mechanisms to

saving behaviour – homeownership and private pension enrolment. The self-employed are distinct from employees in that they are more financially vulnerable as their social security welfare are less guaranteed. In addition, the self-employed can be considered as both private persons and enterprises, and entrepreneurs tend to save, on average, a larger proportion of their income than other people with similar incomes and have a unique and apparently powerful motive to save (Katona, 1960). Employees are used instead because the sample size of the self-employed is too small for empirical estimation being undertaken. Finally, based on the valid samples, elementary data analyses will be presented.

Chapter four considers the econometric frameworks and estimation methods to be applied on three empirical studies, respectively. Firstly, two methods are proposed and explained: a random-effect order Probit model and a seemingly unrelated regression (SUR) model. Because the dependent variable is characterised as qualitatively discrete, the random-effect ordered Probit model is applied for panel-data estimation. The SUR model considers four cross-sectional estimation equations in a single framework, by assuming that correlation exists amongst the equations. Secondly, a random-effect Tobit model is employed, mainly because the dependent variable is censored. Thirdly, a nonparametric kernel smooth quantile estimation method is employed.

Chapter five covers the first empirical study, which is to explore the changes in likelihood of saving motives. First, the results of a panel-data estimation method of the whole sample and the two subgroups – homeowners and private pension participants - are discussed. Second, the estimated results of a SUR model are analysed, in addition, the time consistency of the coefficients of the independent variables, will be examined.

Chapter six is concerned with the second empirical study, and the determinants of saving ratios of a long-term horizon and a short-term horizon will be analysed respectively. Moreover, the influence of habit effects on saving ratios will also be examined in this chapter. The estimated coefficients and estimated marginal effects of the determinants will be reported at the whole sample level and for the two subgroups.

Chapter seven is the third empirical study, and aims to estimate the long-term savings-age and short-term savings-age profiles over the working life cycle, namely between

ages 25 and 65. Analyses are carried out at the whole sample level as well as on five subgroups – males, females, homeowners, private pension participants, and employees. A nonparametric cross-sectional kernel smooth quantile estimation method is employed.

Chapter eight concludes the findings and limitations of this study. In addition, possible directions for future research are proposed.

CHAPTER 2 : LITERATURE REVIEW

2.1 INTRODUCTION

The life cycle model is used to explain the households' intertemporal consumption/savings behaviour. Consumers are assumed to be perfectly able to foresee their future income path, and are inclined to smooth out consumption over the life cycle, in particular, to keep the consumption at a habitual level. The standard model assumes that saving for retirement is the dominant saving motive. However, this is unable to explain the observed household savings behaviour.

Under the standard life-cycle hypothesis, the buffer-stock model has been derived with the key proposition that consumers possess precautionary saving motives, and hence accumulate liquid wealth stock to buffer the shocks of income uncertainty on consumption. In the buffer-stock model, it is assumed that the consumers are sufficiently impatient, implying that they would borrow against future income without income uncertainty, and meanwhile prudent so that they would defer current consumption and put money away.

Although allowing for heterogeneity with time preference across individuals/households, the standard life-cycle model assumes that consumers' time preference is consistent over time. However, this assumption has been proved inconsistent with human being's observed intertemporal decision-making process. It has been found by experimental psychologists that people's preference is dynamically time inconsistent and is depicted by hyperbolas: in brief, the time discount rate with the future is decreasing as the time point is getting further from the present. The consumers with hyperbolic discount function are willing to put away some money when this task will take place in the distant future. However, when the date of action is approaching, the consumers become less willing to do it. Hence, the later selves have the *self-control problem* and are unable to accomplish what the early selves have expected them to do.

Strotz (1955) was the first work that analysed intertemporal choices by providing a theory of dynamic inconsistent preference of a myopic economic individual. In contrast

with Strotz's (1955) investigating the changing (inconsistent) time preference of an individual over time, Thaler and Shefrin (1981) developed a model in which an individual is assumed to have two sets of preferences that are in conflict in a single point in time in which the self-control problem arises. This work was thus the first systematic and formal treatment of a two-self man, which considers there being a planner and a doer within a single individual. Strotz (1955) and Thaler and Shefrin (1981) all suggested that some accessible external pre-commitment schemes or some internal mechanism are applied by an individual, to tackle his/her self-control problem. Accordingly, the concept of *mental accounting* was proposed in Shefrin and Thaler (1988) as internal controlling strategies. The feature of mental accounting indicates that the consumers have a mindset that assigns resources to various accounts, which have a different marginal propensity to consume. Correspondingly, the consumers manage to save money by assigning money to the accounts with relatively low marginal propensity to consume. The idea of mental accounting suggests that assets are nonfungible, and this is in contrast to the standard life-cycle model. More recently, David Laibson (1997, 1998) has developed the quasi-hyperbolic life-cycle consumption model to integrate the feature of inconsistent time preference and the asset-allocation strategies into the framework of the buffer-stock model. The feature of inconsistent time preference posits that the effective discount factor is determined by the weighted interaction between the inclination to consume in the near future and the aim to save for the long-term future. The asset allocation strategies shed light on the asset allocation between liquid assets and illiquid assets of a quasi-hyperbolic consumer: the current individual is inclined to put some resources away in *illiquid* forms in order to impose liquidity constraint on the next-period self's budget and to prevent himself/herself from a splurge in the short run. Similarly, these asset allocation strategies also suggest the feature of asset-specific marginal propensity to consume.

In the quasi-hyperbolic life-cycle consumption model, the precautionary saving effect may be found missing (Laibson, 1997) and this is one anomaly between the buffer-stock model and the quasi-hyperbolic life-cycle consumption model. The intuition emerges: with a short-run perspective, the consumers are too impatient to save and instead are tempted to gain instant gratification; meanwhile, being aware of such a self-control

problem, they tend to accumulate wealth in illiquid forms[17], and leave relatively small amounts of liquid assets accessible.

The standard life-cycle hypothesis states that the main motivation for saving is to accumulate resources for later expenditure, in particular to support consumption at a habitual standard during retirement. Consumption smoothing leads to a humped shape - inversed 'U' - age path of wealth holding (Modigliani, 1986): individual households dissave in young age, save in middle age, and dissave again after retirement. Breaking down aggregate savings by saving motives has been introduced into empirical studies. The buffer-stock model introduces the precautionary saving motive into the life-cycle model, implying that saving for uncertainty also determines the savings-age profile. Furthermore, the quasi-hyperbolic consumption life-cycle model infers that savings made with a short-term perspective may not be consistent with those of a long-term perspective.

Section 2.2 illustrates the theoretical implications of the buffer stock model and the quasi-hyperbolic life-cycle consumption model; in addition, one theoretical anomaly between the two models is explained. Section 2.3 reviews recent relevant literatures and discusses related issues in empirical studies based on the two theoretical models. Section 2.4 concludes this chapter and explains the role of this study.

2.2 THEORETICAL ISSUES

2.2.1 The buffer-stock model

Evolving from the work of Stephen Zeldes (1989), Angus Deaton (1991), and Christopher Carroll, the buffer-stock saving model under the life cycle hypothesis was firstly proposed by Carroll (1992, 1997). Buffer-stock saving behaviour can emerge from the standard dynamic optimization framework when consumers facing important income uncertainty are both *impatient* and *prudent*. The consumers are sufficiently impatient in the sense that if income were certain, they would like to borrow against future income to finance current consumption. On the other hand, they are prudent in

[17] The illiquidity may take the forms of external commitment schemes.

the sense that they have a precautionary saving motive. In Miles Kimball's (1990) sense, the term 'prudence' is meant to suggest the propensity to prepare and forearm oneself in the face of uncertainty. This contrasts with 'risk aversion,' which is how much one dislikes uncertainty and would turn away from it if possible.[18]

The theoretical framework starts with the assumption that the consumers choose consumption to solve the following intertemporal utility optimisation problem (Carroll, 1992, 1997):

$$\max E_t \sum_{i=t}^{T} \beta^{i-t} u(C_i) \tag{2.1}$$

E_t denotes consumers' expectation at time t. $u(C)$ denotes the utility function of consumption (C), and takes the form of the standard Constant Relative Risk Aversion (CRRA): $u(C) = \frac{C^{1-\rho}}{1-\rho}$, where ρ is the coefficient of relative risk aversion; $\beta = 1/(1+\delta)$ denotes the discount factor where δ is the time-consistent discount rate, indicating intertemporally consistent time preference. The dynamic budget constraint is:

$$W_{t+1} = R[W_t + Y_t - C_t] \tag{2.2}$$

where $R = (1+r)$, denoting the constant gross interest rate; W_t denotes the current stock of non-human net wealth; Y_t is current labour income. Labour income changes due to transitory and permanent shocks, both assumed to be log-normally distributed:

$$\begin{aligned} Y_t &= P_t V_t \\ P_t &= G P_{t-1} N_t \end{aligned} \tag{2.3}$$

P_t is permanent labour income[19]; V_t is the white noise *transitory shock* to income; N_t is a lognormally distributed white noise with mean value 1 and a multiplicative shock to permanent income; $G = (1+g)$ denotes the growth factor for permanent labour income.

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[18] Arrow-Pratt index measures of absolute and relative risk aversion have been widely used (Arrow 1965; Pratt 1964). Denote $v(x)$ as a utility function and x for the consumption level; index $-v''(x)/v'(x) = a(x)$ refers to a measure of *absolute risk aversion*, and $xa(x)$ refers to the *coefficient of relative risk aversion*. The index of prudence is thus measured as $-v'''(x)/v''(x) = p(x)$.

[19] The log of P is assumed to follow a random walk with drift: $\ln P_t = \ln G + \ln P_{t-1} + \ln N_t$.

In any period, optimal consumption will depend on labour income of this period and the non-human wealth accumulated, namely, the current total cash-on-hand, denoted as X :

$$X_t = W_t + Y_t \tag{2.4}$$

and the cash-on-hand of the next period is given by:

$$X_{t+1} = R[X_t - C_t] + Y_{t+1} \tag{2.5}$$

Therefore, the consumer's problem can be written as:

$$V_t(X_t) = \max_{C_t}\left\{u(C_t) + E_t \sum_{i=t+1}^{T}\left(\prod_{j=t+1}^{i}\beta^j\right)u(C_i)\right\} \tag{2.6}$$

subject to

$$X_{t+1} = R[X_t - C_t] + Y_{t+1}, \text{ and} \tag{2.7}$$

$$C_T \leq X_T \tag{2.8}$$

Consider a consumer solving the finite horizon problem with last period of life T. The consumer is assumed to spend total resources he has in the last period (X_T), the Euler equation for optimal consumption in the period before last is:

$$u'(C_{T-1}) = R\beta E_{T-1}u'(C_T) = R\beta E_{T-1}u'(X_T) \tag{2.9a}$$

Equation (2.9a) refers to marginal utilities between two periods being equal. Alternatively, it can be expressed in terms of ratios to permanent income P, i.e. $x_t = \frac{X_t}{P_t}$[20], and $c_t = \frac{C_t}{P_t}$. Reconsidering P in terms of equation (2.3), equation (2.9a) can be rewritten as:

$$u'(c_{T-1}P_{T-1}) = R\beta E_{T-1}u'(x_T P_T) = R\beta E_{T-1}u'(x_T G P_{T-1} N_T) \tag{2.9b}$$

---

[20] $x_t = \frac{X_t}{P_t} = \frac{R(X_{t-1} - C_{t-1}) + Y_t}{P_t} = \frac{R(x_{t-1} - c_{t-1})P_{t-1} + Y_t}{P_t} = \frac{R(x_{t-1} - c_{t-1})P_{t-1}}{GP_{t-1}N_t} + \frac{Y_t}{P_t}$

$= \frac{R(x_{t-1} - c_{t-1})}{GN_t} + V_t$

By dividing equation (2.9b) by P_{T-1} and substituting for the value x_T according to the ratio mentioned above, yields

$$u'(c_{T-1}) = R\beta E_{T-1}u'\{[\frac{R[x_{T-1} - c_{T-1}]}{GN_T} + V_T]GN_T\} \qquad (2.9c)$$

Therefore, equation (2.9c) defines the optimal value of the consumption ratio c_{T-1} as a function of x_{T-1}, i.e. $c_{T-1}(x_{T-1})$. A numeral optimal consumption rule is derived by using backwards recursion on the period-by-period Euler equations; therefore, between period $T-1$ and $T-2$, a similar Euler equation holds,

$$u'(C_{T-2}) = R\beta E_{T-2}u'(C_{T-1})$$

$$\longrightarrow \quad u'(c_{T-2}P_{T-2}) = R\beta E_{T-2}u'[c_{T-1}(x_{T-1})P_{T-1}]$$

$$\longrightarrow \quad u'(c_{T-2}) = R\beta E_{T-2}u'\{c_{T-1}[\frac{R(x_{T-2} - c_{T-2})}{GN_{T-1}} + V_{T-1}]GN_{T-1}\}. \qquad (2.9d)$$

Similarly, equation 2.9(d) defines c_{T-2} as a function of x_{T-2}, i.e. $c_{T-2}(x_{T-2})$. More generally,

$$u'(c_t) = R\beta E_t u'\{c_{t+1}[\frac{R(x_t - c_t)}{GN_{t+1}} + V_{t+1}]GN_{t+1}\}$$

$$\longrightarrow \quad u'(c_t) = R\beta \int_N \int_V u'\{c_{t+1}[\frac{R(x_t - c_t)}{GN_{t+1}} + V_{t+1}]GN_{t+1}\}dF(V)dF(N) \qquad (2.10)$$

As can be seen, the function $c_t(x_t)$ is defined by equation (2.10). Because there is no analytical solution for this, numerical methods were used to solve the optimal consumption rule. The numerical methods were illustrated in Carroll (1992, 1997)[21].

[21] It was assumed that in period $t+1$, income would be zero with some possibility, p, i.e. $V_{t+1} = 0$; if income is not zero, V_{t+1} and N_{t+1} are distributed lognormally with expected value $(1-p)$ and 1, respectively.

When income was perfectly certain, consumption growth, denoted as $(\ln C_{t+1} - \ln C_t)$ or $\Delta \ln C_{t+1}$ [22], would be approximately $\rho^{-1}(r-\delta)$. A condition for a sufficiently *impatient* consumer is given as $\rho^{-1}(r-\delta) < g$: such a consumer would wish to borrow against future income if income was certain, the level of consumption must be higher than the level of income, indicating that his consumption growth is slower than income growth[23]. Under income uncertainty, say, if the change in permanent income is distributed lognormally with variance σ^2_{LnN}, the successive consumption rules $c_t(x_t)$, $c_{t-1}(x_{t-1})$, ..., converge[24] if :

$$\rho^{-1}(r-\delta) + (\frac{\rho}{2})\sigma^2_{\ln N} < g - \frac{\sigma^2_{\ln N}}{2} \qquad (2.11)$$

The $\frac{\delta^2_{\ln N}}{2}$ on the left-hand side of equation (2.11) reflects the additional consumption growth induced by the permanent income shocks, and, on the right-hand side, the reduction in the mean growth of the log of income necessary to maintain $E_t N_{t+1} = 1$.

Precautionary saving behaviour generated in the buffer-stock model is given by the Euler equation for consumption growth. Provided that shocks to consumption are lognormally distributed, consumption will grow according to:

$$\Delta \ln C_{t+1} \approx \rho^{-1}(r-\delta) + (\frac{\rho}{2})E_t \operatorname{var}(\Delta \ln C_{t+1}) + e_{t+1} \qquad (2.12)$$

---

[22] To derive this formally, note that the Euler equation in equilibrium is: $u'(C_t) = R\beta u'(C_{t+1}) \rightarrow (C_t)^{-\rho} = R\beta(C_{t+1})^{-\rho} \rightarrow \frac{C_{t+1}}{C_t} = (R\beta)^{1/\rho}$. As making the usual approximation that $\ln[R] \approx r$ and $\ln[\beta] = -\delta$, taking logs of both sides gives the $\ln C_{t+1} - \ln C_t = \rho^{-1}(\ln R + \ln \beta) \approx \rho^{-1}(r-\delta)$.

[23] Approximation can also be made on income growth: $\ln[G] \approx g$.

[24] As mentioned above, the numerical method involves solving the optimal consumption rule in the last period of life, then that in the second-to-last period, then that of the third-to-last period, and so on, until the difference between successive consumption rules is small enough that the consumption rule can be said to have converged.

The key insight in equation (2.12) is that the expected variance of consumption growth, $E_t \text{var}(\Delta \ln C_{t+1})$, will be negatively related to wealth. Consumers with less wealth have less ability to buffer consumption against income uncertainty, thus they have higher $E_t \text{var}(\Delta \ln C_{t+1})$ and faster consumption growth, $\Delta \ln C_{t+1}$. The rate of consumption growth is high when wealth is small because the level of current consumption is being depressed by precautionary saving as a result of prudence.

The theoretical implications on precautionary saving behaviour emerge. Firstly, consumers are assumed to be sufficiently impatient that they would borrow (dissave) whilst income were certain, and are prudent in the sense that they would accumulate (precautionary) wealth to buffer income shocks. The internal tension between impatience and prudence may reach a target wealth/income ratio under which consumers tend to save and above which consumers tend to dissave. Secondly, consumers with higher income uncertainty tend to have higher buffer stock, and such precautionary wealth presumably takes a highly liquid form. Thirdly, although in theory, consumers' consumption-saving decisions are a function of total gross wealth, the appropriate place for the buffer-stock model is an explanation of truly discretionary "high frequency" saving decisions of the median consumers. Moreover, this model is not useful for explaining consumers' life-cycle saving behaviour, for instance, investing in housing wealth and participating in pension plans. (Carroll, 1997)

2.2.2 The quasi-hyperbolic consumption life-cycle model

Following Strotz (1955) and Phelps and Pollak (1968), Laibson (1997, 1998)[25] developed a life-cycle consumption model with a quasi-hyperbolic discount function. The quasi-hyperbolic consumption life-cycle model to be presented below integrates observed behavioural findings of human beings in the experimental field of Psychology, and develops an analytical framework to illustrate the consumers' intertemporal consumption-saving decisions. The psychological notions employed are *inconsistent time preference,* which suggests that consumers have reversed preference or present-

[25] Laibson (1997) names the model as a golden egg model, which put emphasis on the allocation of illiquid wealth and liquid wealth of households. Along with Laibson (1998), this model is also based on the life-cycle hypothesis, thus is considered as well a hybrid of a life-cycle consumption model with quasi-hyperbolic discount function.

biased preference, and this pattern is attributed to the fact that consumers have a *self-control problem* in that they are not perfectly rational as economists have believed. Nevertheless, consumers are aware of such a problem and seek solutions of *precommitments*. The evolvement of incorporating psychological elements into a life-cycle model posits the bounded rationality of consumers in their decision-making behaviour.

Model specifications of inconsistent time preference

In the quasi-hyperbolic consumption model, a consumer is modelled as a composite of autonomous temporal selves interacting as players in a finite-horizon dynamic game. The selves are indexed by their respective periods of control ($t = 0,1,2,...T$), over a consumption decision. The consumption plan subject to budget constraint is an assumption carried over from the buffer-stock model addressed before. Self t receives payoff in utility:

$$U_t(C_0, C_1, ..., C_T) = E_t[u(C_t) + \beta \sum_{i=1}^{T-1} \delta^i u(C_{t+i})] \tag{2.13}$$

subject to

$$X_{t+1} = R(X_t - C_t) + Y_{t+1} \tag{2.14}$$

During period t, the consumer has cash on hand $X_t \geq 0$. He/she chooses a consumption level $C_t \in [0, X_t]$, which rules out borrowing. Whatever the consumer does not spend is saved, $S_t = X_t - C_t \in [0, X_t]$. The gross return, R, on his/her saving is fixed. X_{t+1} denotes cash-on-hand during period $t+1$. Labour income, Y, is independently identically distributed over time with density f. The consumer cannot sell his uncertain stream of future labour-income payments. δ, β in equation (2.13) are discount parameters, and $0 < \delta, \beta < 1$. $u(C) = \frac{C^{1-\rho}}{1-\rho}$ is a utility function with constant relative risk aversion (CRRA) coefficient $\rho \in (0, \infty)$.

A unique sub-game equilibrium exists in a finite-horizon game. This equilibrium is the Markov perfect and is characterised by time-dependent consumption rules which are

linear in wealth. The formal derivation is proved by applying a backwards induction argument (Laibson, 1996). From the perspective of self t, the marginal benefit of postponing 'Δ' units of consumption generates a stream of utility perturbation: whilst $\Delta \cdot u'(C_t)$ utilities are lost at time t, $\beta \cdot \delta \cdot \frac{\partial C_{t+1}}{\partial X_{t+1}} \cdot R \cdot \Delta \cdot u'(C_{t+1})$ utilities are gained at time $t+1$. $\frac{\partial C_{t+j}}{\partial X_{t+j}}$ is the marginal consumption rate at period $t+j$. At time $t+2$, $\beta \cdot \delta^2 \cdot \frac{\partial C_{t+2}}{\partial X_{t+2}} \cdot (1 - \frac{\partial C_{t+1}}{\partial X_{t+1}}) \cdot R^2 \cdot \Delta \cdot u'(C_{t+2})$ utilities are gained, etc.... Therefore, the net effect from period t to the last period T sums to:

$$-\Delta u'(C_t) + \beta \sum_{i=1}^{T-t} \delta^i \frac{\partial C_{t+i}}{\partial X_{t+i}} \left[\prod_{j=1}^{i-1} (1 - \frac{\partial C_{t+j}}{\partial X_{t+j}}) \right] R^i \Delta u'(C_{t+i}) \qquad (2.15a)$$

Setting expression (2.15a) to zero and dividing the equation by 'Δ' yields an Euler equation:

$$u'(C_t) = \beta \sum_{i=1}^{T-t} \delta^i \frac{\partial C_{t+i}}{\partial X_{t+i}} \left[\prod_{j=1}^{i-1} (1 - \frac{\partial C_{t+j}}{\partial X_{t+j}}) \right] R^i u'(C_{t+i}) \qquad (2.15b)$$

The analogous Euler equation for period $t+1$ is:

$$u'(C_{t+1}) = \beta \sum_{i=1}^{T-(t+1)} \delta^i \frac{\partial C_{t+1+i}}{\partial X_{t+1+i}} \left[\prod_{j=1}^{i-1} (1 - \frac{\partial C_{t+1+j}}{\partial X_{t+1+j}}) \right] R^i u'(C_{t+1+i}) \qquad (2.15c)$$

Substituting equation (2.15c) into equation (2.15b) yields the generalised Euler equation below:

$$u'(C_t) = R u'(C_{t+1}) \left[\left(\frac{\partial C_{t+1}(X_{t+1})}{\partial X_{t+1}} \right) \beta \delta + \left(1 - \frac{\partial C_{t+1}(X_{t+1})}{\partial X_{t+1}} \right) \delta \right] \qquad (2.16)$$

The Euler equation (2.16) is different from the standard Euler equation[26] in that a dynamically inconsistent time preference is applied. The intuition behind this equilibrium is that self t gets more marginal utility from incremental consumption in the distant future, denoted as $\left(1-\frac{\partial C_{t+1}(X_{t+1})}{\partial X_{t+1}}\right)$, than from incremental consumption in the near future, denoted as $\left(\frac{\partial C_{t+1}(X_{t+1})}{\partial X_{t+1}}\right)$, as $\beta\delta < \delta$. This arises because the 'overconsumption' problem, which, from the point of view of self t, self $t+1$ will have, *lowers* marginal utility at time $t+1$ relative to marginal utility in future periods.

Therefore, the general discounting term $\left[\left(\frac{\partial C_{t+1}(X)}{\partial X}\right)\beta\delta + \left(1-\frac{\partial C_{t+1}(X)}{\partial X}\right)\delta\right]$ is referred to as the *effective discount factor*, which varies linearly with the next period's marginal propensity to consume (MPC). Intuitively, the effective discount factor weights the discount factor that applies between today and tomorrow - $\beta\delta$ - by the fraction of marginal savings that get consumed tomorrow, and weights the discount factor that applies between all other future periods - δ - by all that remains in the formula. When the MPC is close to one(zero), most weight is place on $\beta\delta(\delta)$, which implies a low(high) discount factor. Thus life-cycle variations of the MPC and hence of the discount factor gives support to the proposition that the intertemporal consumption/savings decisions can be dynamically inconsistent over the life cycle.

As shown in equation (2.15b), the discount function in this model assigns a discrete time discount function with values $\{1, \beta\delta, \beta\delta^2, \beta\delta^3, ...\}$, which is called the *quasi-hyperbolic discount function*, in that it captures the quality of the hyperbolic discount function[27] – in this period the discount rate on next-period utility is greater than the discount rate on the one-period-ahead utility in any period in the future, and keeps analytical tractability of the exponential discount function. Figure 2-1 below graphs the exponential discount function (assuming $\delta = 0.97$), the generalised hyperbolic discount

[26] This equation reduces to the standard Euler equation when $\beta = 1$.

[27] Hyperbolic discount function implies declining discount rate over time. Psychologists have discovered that the discount functions of people's valuing future rewards are displayed as hyperbolas; for instance, Ainslie (1992) reviewed the hyperbolic discount rate of animals' and human's observed behaviour.

function [28] (assuming $\alpha = 10^5$ and $\gamma = 5 \times 10^3$), and the quasi-hyperbolic discount function ($\beta = 0.6$ and $\delta = 0.99$), respectively.

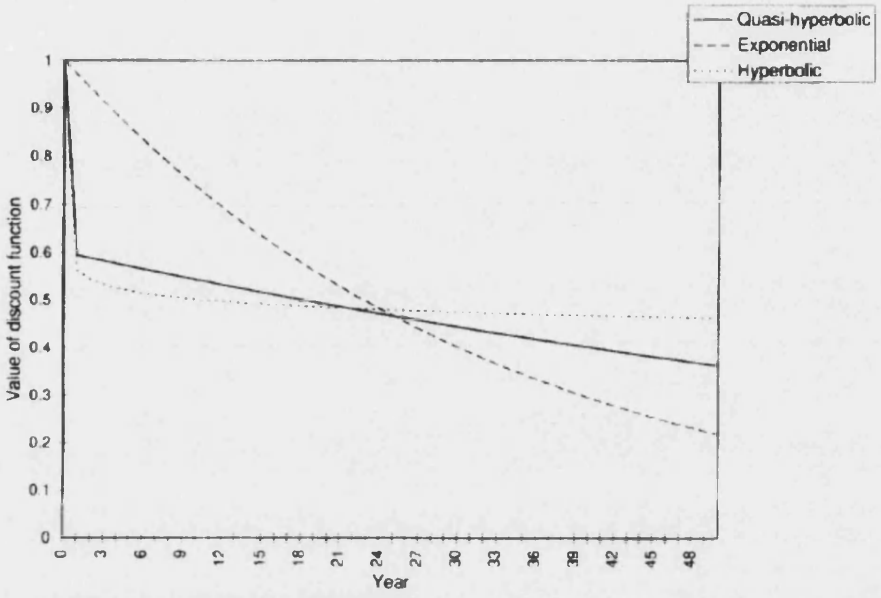

Figure 2-1: Source: Laibson (1998)

Strotz (1955) was the first work that analysed intertemporal choices by providing a theory of dynamic inconsistent preference of a *myopic* economic individual. He posited that whilst the plan is optimal from the perspective of today's individual, the individual tomorrow will likely abandon the plan of today because he will be a different person with a new discount function from the standpoint of tomorrow. Later, Phelps and Pollak (1968) developed a model of the inconsistent time preferences in the context of the intergenerational imperfect altruism. Inconsistent time preference has been proposed as an anomaly against the intertemporal discount utility model on its assumption of a common time preference.

It is generally considered that such inconsistent time preferences occur due to the fact that the consumers have self-control problems: they have a taste for immediate gratification[29] and tend to delay carrying out tasks, namely, to procrastinate[30]. This is

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[28] The discount function is characterised by an instantaneous discount rate that falls at τ rises, $(1+\alpha\tau)^{-\gamma/\alpha}$, $\alpha, \gamma > 0$.

[29] *Gratification* is the positive emotional response to a fulfilment of desire. [http://en.wikipedia.org/wiki/Gratification]

[30] *Procrastination* is defined as the deferment or avoidance of an action or task to a later time.

also termed as the *present-bias preference* by O'Donoghue and Rabin (1999): when an economic agent considers trade-offs between two future moments, present-biased preferences give stronger relative weight to the earlier moment as it gets closer.

In addition to the quasi-hyperbolic consumption model, the influence of the self-control problem was generated in previous theoretical literature: Strotz (1955) noted the self-control problem as the *future* self is not able to follow the plan the *current* self has set up and hoped the future self to follow; Thaler and Shefrin (1981) considered the self-control problem as *internal conflicts of simultaneous preferences within an individual.* Amongst these theories, sophisticated consumers are assumed to be perfectly aware of the self-control problem, whereas naïve consumers do not know about such problems. The division has led to theoretical analysis on behavioural outcomes as a result of the degree of sophistication (O'Donoghue and Rabin, 1999), e.g. O'Donoghue and Rabin (2000) concluded, with some illustrations, that the degree to which a person is aware of self-control problems, is a crucial determinant of the implications of the self-control problems. Having said so, the awareness of the existence of the self-control problems are to be given more attention than the degree of this existence in this thesis. First, tractability is required in a modelling environment, thus it is commonly assumed that economic agents are sophisticated, in the sense that they make use of commitment devices to manage self-control problems. Second, the degree of awareness in each individual's mind is impossible to measure.

When the self-control problem arises as a consequence of inconsistent time preference, economic individuals, even rational and sophisticated, *practically* seek instruments to overcome the problem. Strotz (1955) proposed *'precommitment'* as a strategy in the face of inconsistent time preference. An individual today will try to ensure that he will do tomorrow what is optimal from the viewpoint of today; consequently, the individual, even rational, is *willing to pay a price to precommit to future actions and to avoid temptation.* Thaler and Shefrin (1981) suggested that individuals would favour *rules* to manage the self-control problem. Implementation of precommitment or rules is to control impulsive actions, and in general they take the form of depending on an external agency, such as joining pension plans and a Christmas club, or a form of internal control.

[http://en.wikipedia.org/wiki/Procrastination]

Regarding internal control, two further points can be made: firstly, some rules are considered learned as much as chosen, e.g. rules can be learned from parents or other role models, which implies that there will be a difference in the use of rules depending on social class, education, and age (Shefrin and Thaler, 1988); secondly, rules of thumb easily become habits, which bring rigidities into consumers' behaviour and are dynamically stable (Ainslie, 1975; Shefrin and Thaler, 1988). More recently, featuring the concept of cognitive control developed in cognitive neuroscience, Benhabib and Bisin (2005) explicitly modelled the *internal* commitment mechanism with respect to the self-control problems on dynamic consumption-savings decisions at the macroeconomic level.

Model specifications of self-commitment

The quasi-hyperbolic consumption life-cycle model generates a theoretical implication that consumers, in order to manage self-control problems, impose liquidity constraints on their binding budgets by strategically allocating assets between liquid forms and illiquid forms.

In an economy with highly stylised commitment technology, it is assumed that a consumer may invest in two instruments, a liquid asset X^L, and an illiquid asset Z. Instrument Z is illiquid in the sense that the liquidating of this asset has to be initiated one period before the actual income is received, and this implies that he/she may borrow against his/her Z holdings but will receive cash flow one period later. By contrast, the consumer can always consume his/her X^L holdings immediately. In each period t, the consumer makes consumption/savings decisions in discrete time $t \in \{1,2,...,T\}$. Every time period t is divided into four sub-periods: in the first sub-period, production takes place, and the consumer's liquid assets X^L_{t-1} and illiquid assets Z_{t-1}, which were chosen at period $t-1$, yield a gross return of $R_t = 1 + r_t$, and the consumer inelastically supplies one unit of labour; in the second sub-period the consumer receives deterministic labour income Y_t and gets access to his/her liquid savings, $R_t \cdot X^L_{t-1}$; in the third sub-period, the consumer chooses current consumption, $C_t \leq Y_t + R_t \cdot X^L_{t-1}$. In the

fourth sub-period, the consumer chooses his/her new asset allocations, X_t^L and Z_t, subject to the constraints[31]:

$$Y_t + R_t(Z_{t-1} + X_{t-1}^L) - C_t = Z_t + X_t^L,\ X_t^L, Z_t \geq 0 \qquad (2.17)$$

The left-hand-side of equation (2.17) is considered as savings (S_t) for this period and is to be carried over as part of the resources for the next period. The right-hand side shows the asset allocations, which are decided by current self, in order to make the future self follow its expected consumption path. $Z_t \geq 0$ [32] and $X_t^L \geq 0$ [33], and these constraints exclude forced saving contracts.

Let h_t represents a feasible history at time t and this includes all the actions that have been made from time 0 to time $t-1$: $\{X_0^L, Z_0, (C_\tau, X_\tau^L, Z_\tau)_{\tau=1}^{t-1}\}$. Let M_t represent the set of feasible strategies for self t. Let $M = \prod_{t=1}^{T} M_t$ represent the joint strategy space of all selves. If $m \in M$, let $m \mid h_t$ represent the path of consumption and asset allocation levels from t to T which would arise in the condition that history h_t were realised, and self t to T played the strategies given by m. Finally, let $U_t(m \mid h_t)$ represent the continuation payoff to self t if self t expects $m \mid h_t$ to be carried out. With an attempt to overcome the problem that equilibrium strategies cannot be derived from marginal conditions under an inconsistent time discounting rate, a restriction is put on deterministic labour income process:

$$u'(Y_t) \geq \beta\delta^\tau \left(\prod_{i=1}^{\tau} R_{t+i}\right) u'(Y_{t+\tau}) \quad \forall t, \tau \geq 1 \qquad (2.18)$$

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[31] The consumer begins with exogenous endowments $X_0^L, Z_0 \geq 0$

[32] Creditors are unwilling to make an uncollateralized loan if an asset reallocation leaves the illiquid account negative, because a consumer who received such a loan would not have an incentive to repay.

[33] This condition rules out that the consumer could set X_t^L to any negative value, because in this case, he/she could perfectly commit his/her future savings behaviour and hence his/her consumption level. Having said so, credit card borrowing behaviour may to some extent be against the constraint and the $X_t^L \leq 0$ may occur.

This restriction constrains the sequence $\{Y_t\}_{t=1}^{t=T}$ to lie in a band whose thickness is parameterised by the value of β, and calibration shows that such restriction also allows for substantial flexibility in the deterministic income process. The equilibrium strategies will be characterised under the following definitions:

Firstly, a joint strategy, m, is resource exhausting if $m \mid h_{T-1}$ is characterised by $Z_T = X_T^L = 0$, for all feasible h_{T-1}. Secondly, a sequence of consumption/savings actions, $\{C_{\hat{t}}, X_{\hat{t}}^L, Z_{\hat{t}}, ..., C_T, X_T^L, Z_T\}$ satisfies properties (2.19a)-(2.19d) below if $\forall t \geq \hat{t}$,

$$u'(C_t) \geq \max_{\tau \in \{1,...T-t\}} \beta\delta^\tau (\prod_{i=1}^{\tau} R_{t+i}) u'(C_{t+\tau}) \tag{2.19a}$$

$$u'(C_t) > \max_{\tau \in \{1,...T-t\}} \beta\delta^\tau (\prod_{i=1}^{\tau} R_{t+i}) u'(C_{t+\tau}) \Rightarrow C_t = Y_t + R_t X_{t-1}^L \tag{2.19b}$$

$$u'(C_{t+1}) < \max_{\tau \in \{1,...T-t-1\}} \delta^\tau (\prod_{i=1}^{\tau} R_{t+i}) u'(C_{t+1+\tau}) \Rightarrow X_t^L = 0 \tag{2.19c}$$

$$u'(C_{t+1}) > \max_{\tau \in \{1,...T-t-1\}} \delta^\tau (\prod_{i=1}^{\tau} R_{t+i}) u'(C_{t+1+\tau}) \Rightarrow Z_t = 0 \tag{2.19d}$$

Property (2.19a) is a standard Euler equation relation for an environment where liquidity constraints exist, that is, $C_t \leq Y_t + R_t X_{t-1}^L$. The inequality arises because marginal utility can be too high, which refers to low consumption level, relative to future marginal utility, but cannot be too low, referring to high consumption level, as consumers always have the option to save. Property (2.19b) indicates a situation in which when marginal utility is too high (low consumption level), the liquidity constraint must be binding. Property (2.19c) and (2.19d) reflect the strategic decisions that self t makes when it chooses asset allocation levels, X_t^L and Z_t: property (2.19c) refers to that self t will limit self $t+1$'s liquidity as much as possible ($X_t^L = 0$) if consumption at $t+1$ is expected to be too high relative to what self t would prefer it to be; property (2.19d) suggests that self t will not limit self $t+1$'s liquidity at all ($Z_t = 0$) if consumption at $t+1$ is expected to be too low relative to what self t would prefer it to be. Therefore, the equilibrium theorem emerges:

'Fix any T-period consumption game with exogenous variables satisfies (2.18). There exists a unique resource exhausting joint strategy, $m^* \in M$, that satisfies (2.19a)-(2.19c), and this strategy is the unique (sub-game) equilibrium.'

This theorem proposes that there exists strategic *self-control behaviour* in an inter-temporal consumption/savings decision. Early selves prevent later selves from splurging by using illiquid asset holdings (Z). On the equilibrium path, each self is endogenously liquidity constrained by the allocation choices of earlier selves (X^L). Consumers performing such strategic self-control actions will exhibit asset-specific marginal propensity to consume (MPC). As mentioned, the current self is always endogenously liquidity constrained on the equilibrium path, hence the MPC out of liquid wealth is one and the MPC out of illiquid assets is zero. Theoretical propositions are as follows: let $C_t = C_t(R_t X_{t-1}^L, R_t Z_{t-1})$ represents the equilibrium consumption strategy of self t, then

$$\frac{\partial C_t}{\partial (R_t X_{t-1}^L)} = 1 \ \forall t \geq 2 \qquad (2.20a)$$

$$\frac{\partial C_t}{\partial (R_t Z_{t-1})} = 0 \ \ \forall t \geq 2 \qquad (2.20b)$$

In the quasi-hyperbolic consumption model, consumers are assumed to be sophisticated and realise that they have a self-control problem, which is characterised by a higher discount rate on the decisions in the short-term future than on the decisions in the distant future, namely inconsistent time preference. Intuitively, consumers will be more likely to save for the long term than for the short term. Being aware of such a self-control problem, sophisticated consumers choose to impose liquidity constraints on future consumption by allocating assets into illiquid forms. This is to prevent the future selves, in particular the next period self, from over-consumption; also, illiquid assets generate investment income flow in the future. Whilst the current selves lack immediate access to illiquid assets as a result of the binding decisions of the previous selves, they are tempted to spend most of the liquid assets and current cash flow. This confirms in theory that the MPC of illiquid wealth equals zero whereas the MPC out of liquid wealth is almost or equal to one, from which the implication of asset-specific marginal propensity to consume (MPC) is derived.

The feature of asset-specific MPCs is also realised in the concept of *mental accounting,* which is considered as a type of internal rule for consumers to manage their self-control problems in a behavioural model (Thaler and Shefrin, 1981; Shefrin and Thaler, 1988). The key assumption is that consumers treat components of their wealth as non-fungible, even in the absence of credit rationing, which is contradictory to conventional economic theories. Accordingly, the wealth of a consumer can be divided into three accounts[34]: current income (I), current asset (accumulation of discretionary savings) (A), and future wealth (F); it is *assumed* that the MPC of the wealth is account-specific. This model suggests that:

$$1 \approx \frac{\partial C}{\partial I} > \frac{\partial C}{\partial A} > \frac{\partial C}{\partial F} \approx 0 \qquad (2.21)$$

In expression (2.21), characteristics of account-specific MPCs indicate a prediction in the consumer's consumption/saving behaviour that the portion of wealth regarded as future wealth (F) is more likely to be saved than the portion of wealth considered as current asset (A) as the former account has a lower marginal propensity of consume (MPC) assigned to it than does the latter. Analogously, the portion of wealth regarded as future wealth (A) is more likely to be saved than the portion of wealth considered as current asset (I), as the former account has a lower MPC assigned to it than does the latter account.

The idea of asset-specific MPC proposed in the quasi-hyperbolic consumption model conveys the effect of an external binding force and such a force prevents consumers from accessing to the liquidity. Mental accounting, in comparison, addressed a self-directed *internal* accounting rule within a consumer. Pursuing whether the external constraint or the mental accounting rule is the main attribution of account-specific MPC/asset-specific MPC is not the focus of this thesis. In the real world, there are no comprehensive external commitment schemes for consumers to make use of in order to carry out a rational consumption/savings pattern over the life-cycle, and hence assuming that consumers, to some extent, command an internal controlling power, is reasonable.

[34] Three accounts just represent a general description. In real world, the account of current assets may derive a number of sub-accounts, e.g. for children's education, for holiday, etc. Also, the ways households consider housing wealth and pension plans as assets or future wealth vary from one household to another.

Hence, I would propose that the internal mental accounting rule that the consumer possesses, could persuade him/her to distribute assets in both liquid forms and illiquid forms, as the illiquidity of assets plays a role in preventing consumer from obtaining instant liquidity.

In sum, the quasi-hyperbolic consumption model posits that consumers behave differently in the intertemporal decisions between now and the near-term future from those between now and the long-term future. Accordingly, consumers' savings behaviour for the long-term future may differ to that for short-term purposes.

It can be recalled that in the buffer-stock model, consumers are both *impatient*[35] and prudent, and they save to buffer uncertainty in the next period. By contrast, hyperbolic consumers are too myopic so that they tend to over-consume the savings which is easily accessible when the next period comes. Such controversy was firstly proposed in Laibson (1998) by suggesting that the precautionary saving effect may be missing with hyperbolic consumers. Later on, Laibson, Repetto, Tobacman, Hall, Gale, and Akerlof (1998) used a second order Taylor expansion of the generalised Euler equation of consumption growth yields:

$$E_t(\frac{C_{t+1}-C_t}{C_t}) = \frac{1}{\rho}(1-\frac{1}{R\delta}) + \frac{1}{\rho}\frac{1}{R\delta}(\beta-1)E_t(\frac{\partial C_{t+1}(X_{t+1})}{\partial X_{t+1}}) + O(2) + \varepsilon_{t+1} \quad (2.22)$$

where X denotes total cash-on-hand, $\frac{\partial C_{t+1}(X_{t+1})}{X_{t+1}}$ has been expanded around zero, and $O(2)$ has been substituted for second order terms, which includes the conditional variance term, $\frac{\rho+1}{2}E_t\left[\left(\frac{C_{t+1}-C_t}{C_t}\right)^2\right]$. In the exponential case ($\beta = 1$), the new first order term, $\frac{1}{\rho}\frac{1}{R\delta}(\beta-1)E_t(\frac{\partial C_{t+1}(X_{t+1})}{\partial X_{t+1}})$ vanishes. And the relationship between consumption growth and expected consumption growth conveys the precautionary saving motive. In the hyperbolic case, where $0 < \beta < 1$, estimates of the precautionary saving effect

[35] This is in the sense that they would borrow against future income if future income would be certain.

inferred by $\frac{\rho+1}{2}E_t\left[\left(\frac{C_{t+1}-C_t}{C_t}\right)^2\right]$ will be biased owing to the new first order term. Assuming that the first order term dominates the second order terms, the direction of this bias is given by the co-variation of $\frac{\rho+1}{2}E_t\left[\left(\frac{C_{t+1}-C_t}{C_t}\right)^2\right]$ and $\frac{1}{\rho}\frac{1}{R\delta}(\beta-1)E_t(\frac{\partial C_{t+1}(X_{t+1})}{\partial X_{t+1}})$, and their co-variation is *negative* as $\beta<1$.

The intuition is: in the theory of the buffer-stock model, precautionary saving effect takes place whilst a high consumption growth is observed, and a higher consumption growth is usually associated with a higher MPC in the next period. However, a high MPC in the next period implies a low effective discount factor and consumers tend to be more short-sighted and indulge, than be rational when making savings. The controversy emerges: whilst the buffer-stock model predicts that consumers save in this period to buffer income uncertainty in the next period, consumers with a hyperbolic discount function are reluctant to save for the next period in order to prevent themselves from over-spending.

2.2.3 The savings-age profile over the life cycle

This section gives a brief review of the theoretical implications of the savings-age profile in a standard life-cycle model, where time preference is assumed to be consistent and in a life-cycle model, where time preference is inconsistent, respectively.

Under a standard life-cycle hypothesis

The life-cycle hypothesis states that the main motivation for saving is to accumulate resources for later expenditure and in particular to support consumption at a habitual standard during retirement. Consumption smoothing leads to a humped shape - inversed 'U' - age path of wealth holding (Modigliani, 1986): individual households dissave during young age, save in middle age, and dissave again after retirement. This hypothesis has led to much empirical investigation of whether: 1) households' savings-age profile over the life cycle is humped, or 2) households dissave or decumulate asset after retirement, or 3) both.

Investigating various motives of savings provides insights into the relative importance of them over the life cycle. Whilst the main foreseeable event in one's life is old age and retirement under the conventional life-cycle hypothesis, saving for income uncertainty, namely the precautionary saving motive, has been modelled in the buffer-stock model, as another important driving force of a household's savings profile (Zeldes, 1989; Carroll, 1992, 1997). It is posited that consumers engage in precautionary saving behaviour against income uncertainty until roughly age 45 or 50, and thereafter extend this to include some retirement saving [36]. In Samwick (1998), a life-cycle model was proposed allowing for savings for retirement and as a result of precautionary motives. These modifications on a life-cycle model suggest that there is a decumulation after retirement and an upward path before middle age. Jappelli and Modigliani (2003) commented that '*Refinement of the standard model, allowing for precautionary saving...may affect the age which one should start observing wealth decumulation. It does not, however, affect the main implication of the theory that individual wealth should eventually tend to fall with age, with saving becoming prevailing negative.* ' Moreover, the introduction of saving motives into the standard life cycle model helps to explain some empirical puzzles, e.g. allowing intergenerational transfer (Kotlikoff and Summers, 1981; Kotlikoff, 1988), in particular the bequest motive, and uncertain lifetime duration (Davies, 1981), into the standard life-cycle model, is proposed to explain the enigma of why wealth decumulation, or dissaving, may not be found amongst those who are retired.

Under a life-cycle model with inconsistent time preference

The quasi-hyperbolic consumption model gives up one assumption of the standard life-cycle model, by allowing for inconsistent time preference in perspectives. This model implies that opportunities to save more in the future will be considered more attractive than those in the present (Laibson, 1998; Thaler and Benartzi, 2004), and hyperbolic consumers are more capable of saving for the long term than for the short term: they are aware of the self-control problem, and practice precommitment to accumulate wealth for long-term purposes, and meanwhile their present-bias preference tends to cause immediate consumption and makes them averse to saving for the short term. Accordingly, Laibson (1998) proposed that, in the buffer stock model with hyperbolic

[36] This implication was obtained though a simulation on field data, which will be mentioned in the following section.

agents, individuals/households only build up small wealth stocks to buffer high-frequency income shocks, such as variable income.

By proposing mental accounting as an internal rule to manage the self-control problem, Shefrin and Thaler (1988) suggested that consumers label their wealth according to the time when the wealth will be used, therefore, savings put into an account that is for long-term future purposes are more easily preserved than those put into one that is for short-term future purposes, because people have a higher MPS long-term savings than with short-term savings.

The intuitions of the impact of inconsistent time preference on consumers' saving behaviour and the influence of labelling savings converge to allow for a testable hypothesis: consumers with inconsistent time preference would have more savings for long-term purposes than for short-term purposes. Provided that external saving schemes are available, savings for long-term purposes may pick up the effects of average income growth throughout the life cycle, whereas savings for short-term purposes remain constantly small. Moreover, in equilibrium, a hyperbolic consumer should have a high proportion of illiquid wealth and little liquid wealth, which provides an insight into the asset portfolio of such households over the life cycle.

2.3 RECENT EMPIRICAL STUDIES

2.3.1 Precautionary saving behaviour

Empirical investigation into household/individual precautionary saving behaviour can be categorised into three approaches. Firstly, the uncertainty-savings approach straightforwardly examines the relationship between savings and uncertainty of expectation in the next period. A second approach is to test the Euler equation of consumption growth, i.e. equation (2.12), that conveys the relationship between higher income uncertainty and higher consumption growth. Finally, the insurance-savings approach investigates the hypothesis that consumers who have been sheltered by a private insurance policy or public social security schemes, tend to save less, and this

hypothesis can suggest a wealth replacement effect, between insurance and discretionary precautionary savings.

The most crucial issue which one comes across in an empirical study of precautionary saving behaviour is how to choose a suitable proxy indicator for the measurement of uncertainty. Consumers face different types of uncertainty throughout the life cycle, for instance: longevity risk, health risk, employment risk, earning fluctuations risk, and so on, and these risks are considered to have an impact on households' expectation of their future financial situation, hence affecting consumption/savings decisions, throughout their entire lives.

Every saving decision regarding the expectation of the future, including future uncertainty, involves a time horizon of planning. In theory, precautionary saving behaviour is specified as consumers save more this period to buffer income uncertainty *in the next period.* It is often the case that a field survey collects data of households/individuals on an annual basis. As a consequence, empirical works that aim to test this theoretical insight consider 'a year' as the standard formation of 'period'. Therefore, empirical studies have generally considered uncertainty in the next year as being in the next period.

Proxy for uncertainty/risk

According to the Euler equation of consumption growth, the uncertainty lies in the variability of future consumption. Using the U.S. datasets, Kuehlwein (1991) and Dynan (1993) used consumption variability as the indicator for uncertainty. In the United Kingdom, Merrigan and Normandin (1996) used consumption variability – the fluctuation of consumption changes and the fluctuation of consumption growth – to investigate the precautionary saving behaviour of British households. However, there are some critics. To begin with, in practice, it is likely that consumption variability, especially quarterly consumption variation[37], is not subject to uncertainty, but due to other seasonal reasons, which relate to vacation expenses, children's education fees, etc (Carroll, 1992). Moreover, a high percentage of the consumption variability, especially in food consumption, is attributable to noise. (Shapiro, 1984; Runkle, 1991)

[37] Dynan (1993) used quarterly consumption variability to represent uncertainty.

The theoretical model states that the variability arises in the deviations of a household's actual income and its permanent income, and such deviations are presumed to be comprised of the effects from both permanent and transitory shocks. Income variability thus has been used as an indicator for uncertainty. Carroll and Samwick (1997) measured aggregate variance of income by taking the difference between two detrended incomes for two periods, divided by the length of the duration, to have an annual figure, and this measurement was also applied in Guariglia (2001) and Brown and Taylor (2006). Furthermore, Kazarosian (1997) [38] and Carroll and Samwick (1997) disaggregated the total variance of the annual income innovation, defined as the observed current income and estimated permanent income, into permanent shocks and that of transitory shocks. Guariglia (2001) adopted two related measurements of income variance: one takes the income variance between two periods, by assuming that income shocks are permanent, and the other takes the income variance by assuming that income shocks are temporary. Banks, Blundell, and Brugiavini (2001) disaggregated income variance into two sources: one is common to all birth cohorts and the other is cohort specific[39]. However, these ways of measuring income variability/variance are subject to the problem of selectivity bias. For instance, households in risky occupations, which have high income variance, may have chosen them because they are less risk averse[40] (Guiso, Jappelli, and Terlizzese, 1992; Lusardi, 1997). Moreover, the practices mentioned above inferred expectations from the data about income realization and made assumptions about the process of 'rational' expectations formation. This does not necessarily correspond with households' expectation at the point of decision-making, as researchers in most cases do not have enough information to know how consumers formed expectations regarding income uncertainty. (Dominitz and Manski, 1997)

Carroll (1992) stated that '*In the buffer stock model..., unemployment expectations are therefore important because typically the most drastic fluctuation in a household's income are those associated with spells of unemployment*'. Unemployment risk has become a popular proxy indicator for income uncertainty in a number of empirical

[38] The variance of income over a spell of periods is decomposed into permanent shock and from transitory shock.
[39] The motivation of breaking down income risk is to examine the evidence of risk pooling and risk sharing across generations.
[40] Such a problem also raises attention in that occupation is considered as a proxy for income uncertainty/risk. (Skinner, 1988)

works. In Carroll, Dynan, and Krane (2003), the estimated conditional probability of unemployment serves as a proxy indicator for unemployment risk. This measures the probabilities of currently employed heads of household becoming unemployed in the next period, and this can be seen as a rational expectation of the odds which are conditional on demographic, occupational, and educational characteristics of these people. In the United Kingdom, a similar approach was applied in Benito (2004). However, this method includes the questionable assumption that individuals have an identical mindset regarding their rational expectation of their future uncertainty. (Dominitz and Manski, 1997)

Guiso, Jappelli, and Terlizzese (1992) raised the importance of the role of subjective expectation in measuring income uncertainty. Lusardi's (1998) was the first paper to use subjective data, i.e. the subjective possibility of unemployment, when analysing precautionary saving behaviour in the United States. In the survey, individuals were asked to evaluate the chances that they will lose their jobs in the next year. A measurement of income variance was derived as $p(1-p)Y^2$, where p is the predicted *subjectively-reported possibility* of job loss [41] and Y denotes the income from employment. If the unemployment insurance replacement rate is α, the variance of income becomes $p(1-p)(1-\alpha)^2 Y^2$. In the United Kingdom, this approach was used by Guariglia (2001) and Benito (2004).

Subjective estimates of income uncertainty are well documented in countries where there are comprehensive survey datasets. For example, the Bank of Italy Survey of Household Income and Wealth (SHIW): Guiso, Jappelli, and Terlizzese (1992), Lusardi (1997), Guiso, Jappelli, and Terlizzese (1996), and Jappelli and Pistaferri (2000) used households' subjective expectation on income growth for the next 12 months, to estimate the indicator for subjective income risk. In the survey, respondents were asked their opinions about their labour earnings or pensions 12 months from now, and they were given 100 points to be distributed amongst a given set of opinion categories. The reason for asking respondents to give a weighting was to measure how certain they were about each condition. However, one criticism of this method is that many respondents

[41] The predicted subjective probability is reported from an ordered Probit regression of the probabilities of job loss on a set of job characteristic.

found it to be a very difficult task to understand the question and to assign weights, and thus the rate of non-response was very high (Wärneryd, 1999). Moreover, a specific concern in eliciting probabilities is that respondents may not think probabilistically about uncertain events (Ellsberg, 1961; Zimmer, 1983, 1984; Dominitz and Manski, 1997).

More recently, empirical applications have reinforced the efficiency of using *qualitative* subjectively reported measurement of households' income uncertainty. Murata (2003) employed the expectations of economic situation in the near future and of future public pension benefits, as two indicators of income uncertainty, to explore precautionary saving behaviour in Japan. The question regarding the economic situation was:
'Do you think that Japan's business conditions will be better in the near future?'
Responses were chosen from the following: *'much better, slightly better, no change, slightly worse, and much worse.'*
It was considered that the uncertainty over labour income for the next year, for those who selected *'no change'*, was lower than that of those who replied *'worse'* or *'better'*, with the assumption that households' economic prospects could generally affect the probability distribution of their expected labour earnings. In addition to short-term uncertainty, Murata (2003) applied the *long-term uncertainty* of households regarding their public pension benefit, and this measurement was also in a qualitative form. Moreover, Hochguertel (2003) used subjective future income uncertainty *in the next five years* as a proxy indicator for income uncertainty. In contrast with previous literature that specified income uncertainty as uncertainty expected to occur in the short term future, say, in the next 12 months, the indicators of subjective expectations with income uncertainty applied in Murata (2003) and Hochguertel (2003) have suggested that consumers' expectation of uncertainty in the long-run future, also plays a role in their precautionary savings decisions.

Whilst it has been widely presumed that income uncertainty, in terms of job loss or income fluctuations, is the most influential on households' precautionary saving behaviour, the effect of other types of risk on consumers' savings decisions has also caught the attention of some empirical investigation. (Starr-McCluer, 1996; Chou, Liu, and Hammitt, 2003)

Other related empirical studies

As mentioned in the preceding section, precautionary saving behaviour has been discovered through three relationships: savings-uncertainty, consumption growth-uncertainty, and insurance-savings. According to the Euler equation of consumption growth, the second relationship posits that consumption growth is positively correlated with income uncertainty (Kuehwein, 1991 and Dynan, 1993 on U.S. data; Merrigan and Normandin, 1996; Miles, 1997; Jappelli and Pistaferri, 2000; Banks, Blundell, and Brugiavini, 2001, Guariglia and Rossi, 2002; Benito, 2004[42] on British data)[43]. The third relationship suggests that a certain type of insurance is negatively correlated with precautionary wealth, for the purpose of buffering the corresponding type of risk, as insurance has played a role in protecting people from experiencing unpleasant incidents, and high level of generosity of insurance may crowd out people's attempts in accumulating precautionary wealth (Starr-McCluer, 1996; Gruber and Yelowitz, 1999; Engen and Gruber, 2001; Chou, Liu and Hammitt, 2003). The discussion below will focus on the first relationship, which indicates that savings is positively related to uncertainty.

In the United Kingdom, Guariglia (2001) investigated the impact of income uncertainty on the temporal discretionary savings (flow) for sample households selected from the data of the British Household Panel Survey (BHPS), 1991-1998. This work dealt with two main issues: the estimation method and the proxies for uncertainty. Regarding estimation method, cross-sectional estimation is the most common approach in studying precautionary saving behaviour (Kazarasian, 1997; Carroll and Samwick, 1997, 1998; Guiso, Jappelli, and Terlizzese, 1992; Lusardi, 1998). However, it is known that, at the cross-sectional level, it is impossible to disentangle the effects of proxies of risks from those of other consumer attributes, even if an instrumental variable is carefully chosen (Guiso, Jappelli, and Terlizzese, 1992). Because of these limitations, she applied a panel-data estimation method, which has the advantage of disentangling business-cycle effects and other unobserved effects on households' savings, which cannot be done by a

[42]Exceptionally, Benito (2004) investigated the effect of job risk on changes in households' consumption *level*. The intuition is an increase in unemployment risk leads to postponement of the purchase of consumer durables, as households instead opt to add to their precautionary assets. A similar study in the United States can be found in Carroll and Dunn (1997).

[43] There is more literature that examines the theory of precautionary saving by looking at the effects of income uncertainty on household consumption. (Menegatti, 2007; Bertola, Guiso, and Pistaferri, 2005; Jappelli and Pistaferri, 2000)

cross-sectional estimation method. In her paper, four measures of income uncertainty were employed, ranging from objective income variance to subjective income variability[44]. The results for the panel-data estimates showed that the precautionary saving effect was evident[45]. More recently, carrying out a panel-data estimation method, Brown and Tayler (2006) re-examined the relationship between income risk[46] and savings by using data from the BHPS, 1991-2003, at both individual and household levels. Their findings confirmed that a precautionary saving effect was evident.

The buffer-stock model posits that precautionary savings (wealth) ought to be accumulated in liquid forms, and thus theoretically, liquid financial wealth is considered as the main source of buffer holdings. In the empirical literature, it has become prevalent to relate income uncertainty/risk to households' *assets* in various forms (Carroll and Samwick, 1997, 1998; Lusardi, 1998, Carroll, Dynan, and Krane, 2003; Murata, 2003; Jappelli, Padula, and Pastaferri, 2005), and some empirical studies have even investigated the precautionary saving effect only on household's total net worth (Guiso, Jappelli, and Terlizzese, 1992; Kazarosian, 1997; Lusardi, 1997), from which, the primary source of precautionary wealth can be explored[47]. Carroll and Samwick (1997)[48] evaluated precautionary saving behaviour by respectively regressing three specifications of wealth holdings - very liquid assets, very liquid assets and non-housing, non-business wealth[49], and total net worth - on the income variability uncertainty. The results confirmed that these three types of assets appeared simultaneously evident as the sources of precautionary wealth. Furthermore, Carroll and Samwick (1998)[50] attempted to gauge the proportion of the three types of household wealth, which are mentioned above, attributed to precautionary savings. Interestingly, the result suggested that precautionary savings were not necessarily held in very liquid forms, and the

[44] They are income variance adjusted with subjective probability of job loss, income variability, income variance when income shocks are assumed transitory, and income variance when shocks are assumed permanent.
[45] The last measure of income uncertainty related to precautionary saving only at the 13% significance level.
[46] The way of measuring income risk was similar to the second measure in Guariglia (2001): income variability.
[47] Another possibility concerns the impact of income risk to changes in households' portfolio management strategies (Guiso, Jappeilli, and Terlizzese, 1996; Hochguertel, 2003).
[48] The data of wealth information was selected from the year 1984 and the data for measuring income variability was selected from the years 1981-1987 of the U.S. Panel Study of Income Dynamics (PSID).
[49] Unsecured debt is deducted from here.
[50] Sample included heads of households that were aged 50 or younger, from the 1981 dataset of the PSID.

explanation was that, compared to the extent to what the occurrence of a large shock would cost, the cost of liquidating illiquid assets was small.

More recently, Carroll, Dynan, and Krane (2003) looked at the effect of job loss risk on household wealth holdings. The authors selected the sample from the 1983, 1989, and 1992 waves of the U.S. Current Population Survey (CPS), to estimate unemployment risk based on observable household characteristics, and then related the predicted job loss risk to corresponding household net worth, provided by the U.S. Survey of Consumer Finance (SCF). Interestingly, the results provided *little* evidence that households accumulated more wealth in response to an increased probability of job loss. When the wealth holdings are defined as net financial wealth or net worth without home equity, the precautionary responses are close to zero, at all income levels and are no longer statistical significant. However, net worth, including housing wealth, is correlated with unemployment risk. The results here reinforced the findings in Carroll and Samwick (1998) in that precautionary savings are likely to be held in illiquid forms. Moreover, they point to home equity as a driving force behind the relationship between total net worth and unemployment risk. Hence, this was considered rather counterintuitive to the theoretical implications, and it was proposed that the preference of holding illiquid housing wealth over liquid financial wealth, may relate to consumers with a hyperbolic discount function.

Despite these significant findings, it is worth noting that a cross-sectional relationship between income uncertainty and *wealth* was estimated in Carroll, Dynan, and Krane (2003) as well as in the majority of the empirical studies mentioned above. In addition to the concern about using a cross-sectional estimation method, which was pointed out previously, there are some issues concerning specifying net worth as savings, in *cross-sectional* data. Savings flows, which are specified as the difference between disposable income and consumption in a given period, are a contribution to the changes in the value of wealth. However, these changes in wealth also result from other sources, and one of them can be capital gains or loss, which does not relate to consumers' actions or decision to postpone current consumption for the future (Guiso, Jappelli, and Terlizzese, 1992). In contrast with the literature which considers wealth as savings, Guariglia (2001) and Brown and Taylor (2006) treated savings as the amount of money that individuals managed to put away in a certain period. This specification has the advantage of

showing the extent to which an individual has postponed his/her consumption for the future, in a given period. Moreover, relating such savings to future risk supports the concept of precautionary saving, which is different to connecting the relationship between asset(wealth) and risk, i.e. higher stock of precautionary savings[51] as a result of higher future risk.

In sum, regarding literature on precautionary saving behaviour, discussions about the variety of proxies for uncertainty, estimation methods - cross-sectional or panel data analysis, and the specifications of savings have been presented above.

2.3.2 The quasi-hyperbolic life-cycle consumption model

The fact that people's time preferences are dynamically inconsistent provides a new perspective for economic analyses of consumers' intertemporal consumption-saving decisions. It highlights the importance of looking into consumers' consumption-saving decisions, in the context of short-term purposes or of long-term goals, as consumers' savings decisions for the long term are more likely to be formed as a result of rationality, whereas savings decisions for the short term are strongly driven by consumers' myopia and inclination towards instant gratifications. Previous related empirical studies can be categorised as follows: 1) to measure the time discount rate through laboratory experiment, in order to examine if inconsistent time preferences existed in individuals' decision-making process; 2) to calibrate structure estimation using micro data based on a modern consumption model, using basic assumptions of uncertain future income and liquidity constraint, and to search econometrically for the values of parameters to fit observed data; 3) to launch a natural field experiment.

Estimating time preference

The effect of inconsistent time preference (hyperbolic discounting) can be identified at the point of decision-making of a subject, and in many cases, this has been done in experiments studies. To estimate time preference, a typical experimental study asks subjects if they would prefer £X now or £Y at a specified future date. Often experiments have been conducted with hypothetical rewards, or with 'points' redeemable at the end

[51] Precautionary savings at any date is the stock of extra wealth that results from the past flow of precautionary saving measured during previous discrete time periods.

of the experiments (thereby eliminating any rationale for time preference). Concerning the experimental studies of hyperbolic discounting, subjects were asked how much they would like to require at a specific future date, to make them indifferent to now (Thaler, 1981; Chapman, 1996). Alternatively, the existence of hyperbolic discounting was examined in terms of the pattern preference reversal - a subject may prefer £110 in 365 days over £100 in 364 days, but also prefer £100 now over £110 tomorrow (Kirby and Herrnstein, 1995). Recent literature from laboratory experiments is still not able to come to the conclusion that a human being's time preference takes the shape of a hyperbolic discount function, even though, it is generally rejected that it is in the form of an exponential discount function, and time preference should be time inconsistent and present-biased (Fernandez-Villaverde and Mukherji, 2002; Benhabib, Bisin, and Schotter, 2004). Concerns with the accountability of laboratory experiments are due to the fact that the design of the experiments is seldom immune to issues of strategic manipulability or of framing effects (Benhabib, Bisin, and Schotter, 2004). Evidence of estimating the time discount rate from observed field data is also widespread[52]. However, the complexity of measuring discount rates is located in that, apart from pure time preference, there are many possible factors which have an influence on individuals' intertemporal choices (Frederick, Loewenstein, and O'Donoghue, 2002), such as uncertainty[53], reference-dependent utility[54], etc. These factors can be confounding, but ignoring them could cause bias in the estimation of time preference.

Empirical evidence of the quasi-hyperbolic consumption model

With respect to the theory of the quasi-hyperbolic consumption model, there have been several empirical studies which were carried out largely in *calibrated simulations* on observed field data, in the United States. A common research design emerged: simulated consumption/saving profiles of consumers, who were assigned an exponential discount function, and those of consumers, who were assigned a hyperbolic discount function, were compared. Laibson, Repetto, Tobacman, Hall, Gale, and Akerlof (1998)

[52] Regarding this, Frederick, Loewenstein, and O'Donoghue (2002) have done a comprehensive survey of empirical estimates of annual discount rate via experiments or field data. Dating from 1978 to 2002, these estimates display tremendous variability amongst discount rate measurements– ranging from -6% to infinity.

[53] Empirical evidence suggested that introducing objective uncertainty to both current and future rewards can affect estimated discount rates. (Keren and Roelofsman, 1995)

[54] A standard approach to estimate discount rates assumes that utility function is linear in the magnitude of the choices objects, say the amount of money. However, reference-dependence utility makes this approach invalid. (Kahneman and Tversky, 1979)

conducted simulations of intertemporal consumption-savings choices throughout the life cycle, within three types of economies - one for exponential consumers, one for hyperbolic consumers, and the third for a hybrid economy[55]. The simulation results showed that, compared with the exponential consumers, the hyperbolic consumers are more likely to encounter liquidity constraint, and for them the precautionary saving effect could appear to be missing. Applying similar calibrations, Angeletos, Laibson, Repetto, Tobacman, and Weinberg (2001) investigated the simulated consumption profile, liquid and illiquid wealth accumulation profile, and credit card debt accumulation profile over the life cycle for the first two of the three types of households. Laibson, Repetto, and Tobacman (2005) estimated the respective long-term and short-term time preferences, by using the field consumption data of the Federal Reserve's Survey of Consumer Finances (SCF)[56]. The simulation results indicated that the quasi-hyperbolic discount function fitted more closely the observed higher stock of illiquid wealth before retirement and credit card debt accumulation, than the exponential discount function. The benchmark estimates suggested a 40% short-term annualised discount rate and a 4.3% long-term discount rate. Moreover, Laibson, Repetto, Tobacman, Hall, Gale, and Akerlof (1998) estimated the precautionary saving behaviour[57] on simulated hyperbolic and the exponential economies. The estimated precautionary saving effect[58] was lower in the hyperbolic case, than in the exponential one. The calibration estimation suggested that the precautionary saving effect was weak, or even lost amongst the hyperbolic agents. In general, the simulation studies mentioned above provided evidence for the quasi-hyperbolic consumption model. However, such structural modelling relies on a large set of explicit and implicit assumptions.

Ashraf, Karlan, and Yin (2005) conducted a natural field experiment to explore how individual's time preferences practically influenced their saving decisions, in the

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[55] The dataset for calibrations are largely from the Federal Reserve's Survey of Consumer Finances (SCF) and the Michigan Panel Study of Income Dynamics (PSID).

[56] The calibrations were based on a buffer stock consumption model and included a number of factors that affected consumers' intertemporal consumption-saving decisions, such as liquid and illiquid assets, revolving credit, liquidity constraints, household dependents, retirement, Social Security, and stochastic labour income.

[57] The estimation equation took the form of $\frac{C_{t+1}-C_t}{C_t} = \alpha_0 + \alpha_1\left(\frac{C_{t+1}-C_t}{C_t}\right)^2 + \varepsilon_{t+1}$, according to the Euler equation (2.22). $\frac{C_{t+1}-C_t}{C_t}$ is instrumented by the resources reserved – savings - at time t.

[58] This is represented by the coefficient α_1.

Philippines. To begin with, they examined individual's time preferences by asking hypothetical questions. Next, they explored whether those who had exhibited hyperbolic preferences previously, made saving decisions which were consistent with the theoretical implications, i.e. taking up a commitment mechanism of savings[59] to manage a self-control problem.

In Ashraf, Karlan, and Yin (2005), the effectiveness of a commitment savings account on financial savings was evaluated. The findings suggested that there was a strong positive impact from saving commitment on increases in savings. Thaler and Benartzi (2004) designed a savings programme for a field experiment, to explore whether people who undertake a savings commitment would save more than those who do not. The key findings were: first, a high proportion (78 percent) of those offered the plan joined, second, the average saving rates for the programme participants increased from 3.5 percent to 13.6 percent, over the course of 40 months. These empirical findings point to the possibility that those who precommit themselves to saving for the future may eventually save more. In contrast with this, under a standard life-cycle hypothesis, the existence of a state pension system or private pension system has raised the issue as to whether or not this would have a crowd-out effect on discretionary savings. Attempts to measure the impact of public pension and private pension wealth on household private saving, namely the wealth replacement effect, have taken up much empirical investigation (Feldstein, 1974; Alessie, Kapteryn, and Klijn, 1997; Attanasio and Brugiavini, 2003; Attanasio and Rohwedder, 2003; Jappelli, Padula, and Bottazzi, 2003). As can be seen above, an anomaly has emerged amongst these empirical studies.

Empirical studies on the quasi-hyperbolic consumption model are largely based on simulations and there are a few based on field experiments, but empirical estimation appears to be rare. Moreover, empirical studies which bring the concept of inconsistent time preference or hyperbolic discount function into analysing British households, to this researcher's knowledge, have not been undertaken.

[59] The authors also evaluated the effectiveness of using a commitment savings account on financial savings. The results showed that the participants that took up this product had a higher probability of increasing their savings after twelve months, relative to the control groups. In addition, there is other field experimental evidence on the effect of saving commitment mechanisms on an increase in individuals' savings. (Choi, Laibson, Madrian, and Metrick, 2001; Thaler and Benartzi, 2004)

2.3.3 Empirical evidence of savings-age profiles

The standard life-cycle hypothesis posits that the main motivation for saving is to accumulate wealth for later expenditure and in particular to support consumption at the habitual standard during retirement. The consequence of consumption smoothing throughout the life cycle, leads to a humped shape age path of wealth holdings (Modigliani, 1986): individual households dissave, namely borrow, in young age, save in middle age, and dissave again after retirement. This theoretical implication has drawn much of the attention of researchers in the context of advancing empirical examinations via field data. In the literature concerning savings-age profiles, two issues have emerged as important: one is the specification of savings, and the other is the estimation methods to be applied.

Specification of savings

The issue related to the specification of saving/savings has merited a wealth of discussions. In a conventional life-cycle model, a perfect market is assumed to be existent and thus household assets are assumed to be fungible. Therefore, the related empirical literature largely specifies savings as the total accumulated changes of wealth up to some time point, i.e. total wealth stock, or as the periodic changes of wealth (Börsch-Supan, 1992; Horioka and Watanabe, 1997; Alessie, Lusardi, and Aldershof, 1997; Carroll, 1997; Samwick, 1998). Savings derived from the change of wealth could take up not only the household decisions to save, but also the capital gains or losses on the assets or liabilities held in the household portfolios. Alternatively, income[60] net of consumption is employed as the measure of saving/savings (Attanasio, 1998; Jappelli and Modigliani, 2003). Similarly, in a recent paper of Demery and Duck (2006), who investigated the path of saving ratio over the life cycle for British households and individuals, specified saving ratio as the log of mean income minus the log of mean consumption. Different specifications of savings under a life-cycle model were examined, simultaneously, in a recently work by Börsch-Supan and Lusardi (2003). As understood, the definition of savings/saving is customised with regard to two aspects: one is to justify the core of the research question, and the other is to find out to what

[60] Issues of estimation of income range from adjustment of mandated contribution to social security to imputed rent of living in current property.

extent the field data can provide the information needed to construct an empirical investigation. In the first sense, given that the research focus is on the disposability of resources at a given age phase, the specification of total wealth holdings would be favoured. On the other hand, researchers seeing saving(s) as the evidence of intertemporal consumption-savings decisions would give preference to identifying savings as the difference of temporal income and consumption. In the second sense, the plausibility of developing the measurement from the field data is highly subject to the comprehensive nature of a given data set.

Related issues in estimation

As understood, age effects (life-cycle effects), cohort effects (year of birth effects) and time effects (business-cycle effects) evolve within a complex mechanism which has an influence on a household's savings profile over the life cycle. In order to disentangling these three effects, some practices related to estimation methodologies need to be taken. For instance, time effects can be assumed to sum to zero and are orthogonal to linear (time) trends (Deaton and Paxson, 1994; Attanasio, 1998). Using a time series of cross-sections from the U.S. 1980-1991 Consumer Expenditure Survey (CEX)[61], Attanasio (1998) explored age effects by applying a cross-sectional parametric estimation - regressing average saving rates[62] on the fifth degree of polynomial in age. Jappelli and Modigliani (2003) considered cohort effects, age effects, and time effects, by including dummies of these effects in the estimation equation of savings. This parametric estimation was carried out on a time-series of cross-sections, spanning the years 1989-2000 of the Italian Survey of Household Income and Wealth (SHIW). Demery and Duck (2006) also included dummies of these effects in a parametric estimation. As can be seen above, treatments to identify cohort effects from age effects can be applied on long panel or pseudo-panel field data. The advantage of applying panel-data analysis is that changes in the savings profile of a single economic agent can be tracked over time. However, it is often the case that a genuine balanced panel does not exist. Under these circumstances, repeated cross-sectional data (a pseudo-panel) is usually considered as an alternative. A pseudo-panel can be formed by household surveys which are carried out on a regular basis, e.g. annually, and in each year, the survey sample is randomly selected from a large population. The British Family Expenditure Survey is an example

[61] Note that CEX is not a panel, but a time series of cross sections.
[62] This is defined as the ratio of savings to consumption.

of a pseudo-panel dataset, as it surveys about 7000 households annually. In a pseudo-panel, a cohort, instead of an individual, is tracked over time, and estimation of economic relationships is based on cohort means rather than individual observations. One cohort could be the set of all females born between 1970 and 1975 or the set of all individuals of the same age. Deaton (1985) argued that pseudo-panels do not suffer the attrition problem that happens on genuine panels. The justification of this study lies in that even though some observations appear only once amongst all of the cross sections, a sample from the same age cohort is observed in the other waves. This makes it plausible to track the savings, not of the same observations, but of a representative sample of individuals of the same age cohort.

Recently in the United Kingdom, Demery and Duck (2006) used a parametric panel-data estimation method to analyse the relationship between savings and age structure, by regressing the saving ratio[63] on the age dummies, cohort dummies, and year dummies and other control variables for the UK Family Expenditure Survey (FES) dataset over the years 1969-1998. The estimation was done, not only at the household level, but also at the individual level. Estimation of the individual savings-age profile was made, in order to tackle the sample selection bias: such a problem can be seen amongst households with young heads and elderly members, as the elderly members usually have a higher propensity to save and this can lead to overestimation of the saving ratio of the young heads. Therefore, treatments were taken to extract individual income (consumption) estimation from the household survey (Deaton and Paxson, 2000). Despite the aforementioned, it has been a common practice to estimate savings profile at household level in the relevant literature. This is consistent with the traditional theoretical position in that the life-cycle hypothesis was originally derived to explain households' savings profile.

Compared with parametric estimation, non-parametric estimation methods can proceed without imposing any assumption on a sample's distribution. Alessie, Lusardi, and Aldershof (1997) applied a non-parametric approach on two cross-sectional datasets[64] – years 1987-88 and 1988-89 – of the Dutch Socio Economic Panel (SEP), to estimate the

[63] Based on a life-cycle model, the saving ratio of an *individual* is defined as the log of mean income minus the log of mean consumption.
[64] The two cross sections can be integrated into a balanced panel.

distribution of household savings, in three quartiles, over the life cycle. This method is of particular use as a descriptive tool to analyse the relationship between savings and age groups. Also, median analysis is preferred to mean analysis, when a sample is skewed, which is common in a survey of household savings and income. A non-parametric quantile analysis has been frequently employed to explore wealth accumulation against age structure, over the life cycle. (Magee, Burbidge, and Robb, 1991; Robb, Magee, and Burbidge, 1992)

Empirical findings have not converged to favour or to counter the theoretical predictions. Amongst British households and individuals, Demery and Duck (2006) found that the estimated saving ratio-age profile, at both household level and individual level, showed a humped shape between ages 25 and 65, which was predicted by the life-cycle model; the profile at the household level appears to be flatter. Alessie, Lusardi, and Aldershof (1997) found that the distribution of savings in the third quartile, whether including housing equity or not, showed a hump with a peak between ages 45 and 50. On the contrary, the distributions of savings in the median and in the first quartile did not support the life-cycle hypothesis. Attanasio (1998) found that the saving rate[65]-age profile displayed itself as a pronounced hump, peaking at age 57. By contrast, Demery and Duck (2006) also found saving ratio tended to rise after retirement; Börsch-Supan (1992) found that savings for elderly German people were increasing from age 66 onwards. These results contrasted with the theoretical implications of the life-cycle model. On the other hand, Jappelli and Modigliani's (2003) findings supported the life-cycle hypothesis of humped wealth, or savings turning negative after retirement.

Behind the aggregate savings

Looking at the heterogeneity of saving motives becomes a useful perspective for a better understanding of the savings profile. Based on the buffer-stock model, some simulation evidence can be found regarding the path of precautionary savings over the life cycle. Carroll (1997) simulated a median financial wealth/income ratio-age profile, by using the 1960s U.S. data. In brief, the calibrated savings-age profile displayed itself as an inverse V shape[66]. Furthermore, Samwick (1998) used the 1992 U.S. Survey of

[65] This paper uses an unconventional definition saving rate, savings/consumption. This design of the variable is claimed to have the advantage of defining zero income and negative income outliers.

[66] The calibration predicted that very early in working life the wealth/income ratio is low yet above zero;

Consumer Finance dataset to simulate the expected wealth[67]-to-income ratio distribution over the life cycle. To illustrate the degree of impatience, the author compared the profiles of various time discount rates. The profile of the most impatient case was depicted by an inversed V shape: staying constantly low between age 25 and age 55, increasing upwards from age 55 to 65, and declining after age 65, whereas the profile of the most patient case was more of a humped shape. Samwick's simulation provides an interesting inference that savings profile of a consumer who has a *high discount rate* with now and the next period, may be constantly low during young and middle age. Horioka and Watanabe (1997) explored the paths of net savings[68] for various motives - the life-cycle motives, the precautionary motives, and bequest motives - of Japanese households[69] over the life cycle. The findings suggested that the retirement motive and the precautionary motives were of dominant importance. However, savings profiles for different saving motives exhibit paths which are not necessarily humped in shape, e.g. the path of net savings for retirement exhibited an upward trend between ages 20 and 70. As illustrated above, breaking down aggregate savings by saving motives is useful for a better comprehension of the composition of savings, over the life cycle. Nevertheless, empirical studies do not commonly employ the itemisation of savings by different motives. This is ether because, the field data that provides such information is rare, or practically speaking, it is not possible to parse savings into every motive component on an *ex ante* basis, because each unit of money can effectively serve more than one purpose (Dynan, Skinner, and Zeldes, 2002; Jappelli, 2005), e.g. part of bequests left or received may constitute unintentional bequests, resulting from the holding of wealth for precautionary reasons.

Under the standard life-cycle hypothesis, where time preference is consistent over time, wealth allocation is related to households' risk-taking investment behaviour regarding age structure, (Ameriks and Zeldes, 2004), or to the exploration of the decumulation of different assets after retirement (Börsch-Supan and Stahl; 1991; Milligan, 2005).

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for the middle two decades, it grows slightly, then in the last decade before retirement the wealth ratio grows sharply; wealth/savings fall sharply after retirement, reaching zero in the year of death.

[67] The expected wealth is a function of a list of parameters: the expected growth rate of income, the income uncertainty, the replacement rate on retirement income, and interest rate earned on savings, the coefficient of relative risk aversion, and the rate of time preference.

[68] The savings were estimated as the financial asset which households had accumulated and planned to accumulate. The figure of net savings of each household was obtained by: accumulation of financial asset + loan repayment – decumulation of financial asset - newly incurred debt.

[69] The data was from the 1994 Japanese Survey on the Financial Asset Choice of Households.

Moreover, the distinction of mandatory savings and discretionary savings is considered important in order to gain empirical insight into the life-cycle model (Jappelli and Modigliani, 2003; Börsch-Supan; 2003, Milligan, 2005). As discussed in section 2.2.3, households' portfolio strategies, e.g. particularly the relative weights of liquid wealth and illiquid wealth, and level of unsecured debt, over the life cycle, can relate to consumers who have inconsistent time preference, in that these consumers would manage their self-control problem, by means of asset allocation strategies, e.g. mental accounting. Hyperbolic consumers would have relatively high illiquid wealth, low liquid wealth, and high unsecured debt. See 'A Debt Puzzle' in Laibson, Repetto, and Tobacman (2000). Simulated paths of liquid wealth, illiquid wealth, and total wealth, over the life cycle which were exhibited in Angeletos, Laibson, Repetto, Tobacman, and Weinberg (2001), showed that the whist the illiquid wealth-age profiles are humped, under an exponential discount specification and a hyperbolic discount specification, the liquid wealth profile of the hyperbolic case is lower with regard to level and flatter in terms of the curve, than in the exponential case[70]. This supports the implication of external commitment in the quasi-hyperbolic consumption model.

Referring to the theoretical implications of a life-cycle model with inconsistent time preference (section 2.2.3), such economic agents would have more savings for long-term purposes than for short-term purposes. Provided that external saving schemes are available, savings for long-term purposes may pick up the effects of average income growth throughout the life cycle, whereas savings for short-term purposes remain constantly small. Thus far, no empirical studies have been developed to disaggregate savings into from a long-term and from a short-term perspective, which may provide insight into understanding the influence of inconsistent time preference on the relationship between household savings and age structure.

2.4 CONCLUSION

Experimental scientists – experimental economists and psychologists - have indicated that dynamic inconsistent time preference ought to be observed in the course of decision making processes. This work does not aim to employ an experiment to further confirm

[70] Refer to figure 5 in the Angeletos, Laibson, Repetto, Tobacman, and Weinberg (2001), p59.

whether or not people's savings behaviour displays hyperbolic time preferences. The essence of the quasi-hyperbolic discount function brings about the perspective that people's temporal choices can be broken down into a long-term perspective and a short-term perspective, because the hyperbolic consumers value immediate consumption more than putting money away in the short term, but meanwhile they are conscious of the importance of saving money for the long run. Taking this on board for this work, the consumers' observed long-term savings behaviour and short-term savings behaviour are examined separately so that the empirical findings can be examined within the scope of the behavioural models.

The buffer-stock model posits that households perform precautionary saving to buffer income uncertainty in the near future; however, in contrast to this, the quasi-hyperbolic life-cycle consumption model suggests that the precautionary saving effect may be missing. This anomaly develops because the hyperbolic households, faced with income uncertainty in the next period, would save in this period and would sequentially have a high MPC in the next period. This is in contrast to the situation that the high MPC in the next period suggests that the precautionary wealth saved would in all likelihood be spent.

To tackle the temptation of immediate gratification, the hyperbolic households, in this period, are inclined to put away only a small amount of money for the near term future (the next period), and meanwhile save for long-term purposes as a result of rationality. Putting assets in illiquid forms thus becomes the preference of the hyperbolic households, because this enables the savings to be carried on and not to be withdrawn until the time in the distant future when the accumulated wealth is needed for use.

The first stage empirical work looks at the likelihood of short term saving motives and long term saving motives with respect to the households' short term income uncertainty, whether they have become involved with illiquid wealth accumulation and, whether they have explicitly committed themselves to retirement savings schemes, and the households' demographic variables. Much of the literature has emphasised on investigating whether joining in a savings mechanism makes people end up having more savings. It may be that people will have more pension wealth on the day they retire, if they pay into pension schemes from now on; on the other hand, they might thus

become less cautious with long term savings, which may militate against the effect of pension savings schemes. Thus, this work contributes to the view: the awareness of the self-control problem encourages consumers to bind themselves by accumulating illiquid wealth or by paying into a pension scheme, and it is worth looking into whether this self-imposed constraint has any impact on their discretionary saving motives – both long-term and short-term. In the second stage, a simple weight standard is applied to estimate each household's short-term savings and long-term savings, and the relationship between the two types of savings and other control variables mentioned above is examined. In the third stage, the total savings against age profile is estimated, and then the distribution patterns of the two types of savings throughout the life cycle are investigated separately.

Hence, this work contributes to the literature on savings behaviour by re-examining the buffer-stock behaviour in terms of the relationship between the short-term savings/saving motive and uncertainty, whereas, most, if not all, previous investigation has concentrated on the correlation between financial wealth or even the total net worth and uncertainty and left the savings for long term and for short term undistinguished. This disregarded not only the heterogeneity with the variety of consumers' saving motives, but also, as proposed in this work, that consumers may behave dynamically inconsistently with saving for the short tem and with saving for the long term. This reinforces the need to disaggregate households' savings/saving motives into for long-term purposes and for short-term purposes to reflect this inconsistency.

In contrast to previous works that examined the hyperbolic discount function by calibration, this work investigates the hypothesis of the inconsistency of saving behaviour for a long-term time perspective and that for a short-term perspective on field survey data. In addition, as the quasi-hyperbolic consumption model posits that a hyperbolic consumer prefers accumulating assets in illiquid forms as a result of being rational with long-term saving, an intuition is derived: the hyperbolic households' saving motive for long-term purposes should be reflected in their inclination to accumulate illiquid wealth and to save through external commitment schemes, such as private pensions. Also, their high discount rates with decisions in the short-term future may diminish the level of the short-term savings/saving motive.

Finally, this work explores the respective distributions of long-term savings and the short-term savings across age groups. This study attempts to provide empirical evidence for the implications of the behavioural models that two types of savings, as a result of two different time preferences, exist over the working life-cycle. Whilst the conventional life-cycle assumes that rational consumers have a hump-shaped savings distribution across the life cycle, hyperbolic consumers may exhibit a hump-shaped long-term savings distribution, as they are rational with long-term decisions. On the other hand, the short-term savings distribution ought to show a flat profile across the life cycle, because the hyperbolic consumers only keep a relatively small amount of money for short-term purposes.

CHAPTER 3 : DATA

3.1 INTRODUCTION

This empirical investigation is based on the dataset from the British Household Panel Survey (BHPS). The British Household Panel Survey (BHPS) is a nationally representative unbalanced panel survey of the British population, and it provides information on respondents' demographic, occupational, educational, employment and earning, finance, and so on. Owing to its being household-based, the BHPS was designed as an annual survey of each adult member, aged 16 and over, of a nationally representative sample of more than 5000 households, making a total of approximately 10000 individual interviews drawn from 250 areas of Great Britain. Children are interviewed once they reach the age of 16. Additional samples of 1500 households in each of Scotland and Wales were added to the main sample in 1999, and in 2001 a sample of 2,000 households was added in Northern Ireland, making the panel suitable for UK-wide research. The panel includes both male and female individuals, who are aged 16 and over and are in or out of employment.

The same individuals are re-interviewed in successive waves and if they leave their original households, all adult members of their new household are also interviewed. Thus, the sample should remain broadly representative of the population of Britain as it changed through the 1990s and beyond. The survey is carried out annually in October of each year, collecting the individual's information dated from the October of the previous year to the September of the survey year. By the time this research commenced, the available dataset of the BHPS covered from wave 1 to wave 13. The survey year of wave 1 covers from October 1990 to September 1991, and that of wave 13 is from October 2003 to September 2004.

Since wave 1, individuals have been asked about how much, on average, they manage to save per month. Since wave 3, individuals have been asked about their reasons for saving. In wave 10 (year 2000-2001), the individuals have, for the first time, been asked to distinguish between their short-term or long-term savings, accumulated during the past year. The individuals interviewed in the consecutive waves were also asked this question. Accordingly, the dataset available for this study consists of wave 10, wave 11,

wave12, and wave 13, covering years 2000-2004 as information about individuals' saving behaviour - motives and savings amount - regarding different time horizon, can be obtained.

In section 3.2, the constructions of the dependent variables subject to the content of the survey questions, which are saving motives in the first stage, saving ratio in the second stage, and savings amount in the third stage, are illustrated. Comprehensive descriptions of these dependent variables are made. Moreover, the relevant explanatory variables are presented in detail and necessary theoretical and empirical justifications are also considered. The empirical studies are carried out at the household level, and this is mainly because the theoretical implications of both the buffer-stock model and the quasi-hyperbolic life-cycle consumption model have been developed under the assumption that a household is considered as a consumer unit. Because of this, the saving motives in the first stage refer to those of heads of household. In reality, it is impossible to obtain socioeconomic factors and demographic features at household level. Accordingly, the demographic characteristics of the heads of the household are assumed to represent their households. The only exception is that the permanent income variable of a household with its head recognised has been measured at the household level, by summing up the respective income of the individuals within the household. In the second and third stages, saving ratio and savings amount will also be measured at household level.

In section 3.3, the selections of the samples for this empirical study are described consecutively. Next, the samples are filtered with respect to the other criteria, such as age, employment status, etc. The whole samples include heads of the household who are aged between 25 and 65 and in employment (self-employed/employee). In addition, because saving motives and savings amount are dependent variables, the samples are restricted to the heads of the households and other members of the households who give clear responses on their saving motives and the amount of money they have managed to save. Moreover, samples of two sub-groups – homeowners and private pension participants – are constructed respectively. Regarding the subgroups chosen, there is overlap between the two samples; nevertheless, as both of the groups are considered as households who commit themselves to illiquid long-term savings via different instruments, carrying out the comparisons between them is considered to be insightful.

Eventually, the valid sample sizes of the whole samples and each sub-sample are tabulated. Moreover, elementary data analysis is demonstrated: firstly, the basic descriptive statistics of the dependent variables are outlined. Succeeding this, simple cross-tabulation is applied as a preliminarily investigation of the relationship between the dependent variables and the key explanatory variables. In addition, the association between the main explanatory variables is also demonstrated. Finally, section 3.4 ends with a conclusion.

3.2 SURVEY QUESTIONS AND VARIABLES CONSTRUCTION

3.2.1 Construction of dependent variables

From wave 10 onwards in the British Household Panel Survey (BHPS), every individual adult of the annual survey was asked:

- '*Do you save any amount of your income for example by putting something away now and then in a bank, building society, or Post Office account other than to meet regular bills? Please include share purchase schemes ISA's and Tessa accounts.*' -

Individuals who answered "*yes*" were then asked:

'*About how much on average do you personally manage to save a month*?' Individuals answering with the savings amount stated or answering '*don't know*' were asked,

- '*What are you saving for?*' - and

- '*Would you say your savings are mainly long term savings for the future or mainly short term savings for things you need now and for unexpected events*?' The list of responses is: '*Mainly long term* (coded as 1)', '*Mainly short term* (coded as 2)', '*Both equally* (coded as 3)', '*Not applicable* (coded as -8)', '*Proxy respondent* (coded as -7)', and '*Don't know* (coded as -1)'.

3.2.1.1 Saving motives

The last question which is mentioned above asked every individual in a household whether their primary saving motive was for the long term, for the short term, or for both equally, provided that they had reported that they had saved in the past 12 months.

The long-term saving motives were reckoned to be for retirement or any other long-term purposes, such as leaving bequests to the next generation. On the other hand, the short-term saving motives were considered as precaution with short-term uncertainty or other expenditure that was planned with certainty to be used in the short-term future. This question reveals respondents' primary preferences in terms of the planning time horizon of an intertemporal saving decision. These field observations allow for an investigation into households' savings decisions regarding a short-term and a long-term perspective[71], which, as suggested by the quasi-hyperbolic discount function hypothesis, relates to inconsistent time preference. Accordingly, the precautionary saving effect can be reinvestigated via the relationship between the short-term saving motive and short-term uncertainty. In the literature of households' saving behaviour, total savings have often been the object of observations; however, it is understood that this gives rise to the concern of ignoring the heterogeneity of household's saving motives, which may be detrimental to attaining accurate estimation results. Regarding this, this work partially resolves the issue of the heterogeneity of saving motives by distinguishing motives into that for the long term, for the short term, and for both equally. The first-stage study aims to investigate how the changes in household's saving motives varies between mainly for the long term and mainly for the short term and other important factors that may have an effect on these saving motives.

3.2.1.2 Saving ratios

Referring to the survey questions listed previously, the first two questions revealed the interviewed individual's monthly discretionary savings flow, which could be transformed into an annually-equivalent figure. Savings here referred to the difference between individual disposable income and expenditure, and they did not take into account regular instalments in housing wealth, for instance, a mortgage. Furthermore, individuals were asked to state what amount of savings was mainly for the long-term future or mainly for short-term needs and unforeseen events. As mentioned above, this question had the advantage of pinning down savings as a result of heterogeneous motives; in addition, it helped to match each individual's stated savings amount with his/her main saving motive - mainly short term, mainly long term, or both equally.

[71] It is assumed that individual's saving behaviour was consistent with the reported saving preferences.

Before measuring long-term savings and short-term savings at household level, each individual's long-term savings and short-term savings were measured with a simple weighting rule; given that this study is performed at the household level, each household's long-term and short-term savings can be measured by aggregating its individual member's long-term and short-term savings. The rule of imputing short-term savings is as follows: 100% weight is given on the individual's reported amount of savings if he/she saved mainly for the short term, 50% weight if he/she saved for both equally, and 0% if he/she saved mainly for the long term. The weighting standard developed here tends to generalise the proportion of savings as a result of buffering uncertainty in the near-term future and of current needs. The individuals who saved mainly for the long term thus gained zero weight on the item of short-term savings, the individuals who saved for both long-term and short-term gained a half weight, and individuals saving mainly for the short term gained a full weight. Analogously, each individual's long-term savings is measured as follows: 100% weight is given on the individual's reported amount of savings if he/she saved mainly for the long run, 50% weight if he/she saved for both equally, and 0% if he/she saved mainly for the short run[72]. In order to measure the short-term and long-term savings amount for an individual, only those individuals who reported their savings amount and specified clearly whether the savings were for the long term, the short term, or for both equally, were selected. After measuring each individual's savings, they were aggregated at the household level with heads of households identified. Finally, only the savings amount of those households whose heads met the criteria of sample selection, were considered as valid observations. Saving amounts as well as income in this study are deflated according to the index numbers of September of each year of the monthly Retail Prices Index (RPI). Index number of January 1983 =100,[73] and the money value in each wave of this study is deflated at the price level of September 2000.

The measured short-term savings accumulated in the past 12 months are for any purpose of certainty (things needed now) and/or for uncertainty (unexpected events), and the

[72] This research is aware of that when measuring short-term (long-term) savings amount, giving 0% to an individual saving if he/she saved mainly for long term (short term) is at the expense of underestimating his/her short-term (long-term) savings. However, this study assumes that an individual's long-term (short-term) saving motive is trivial when he/she saves mainly for the short term (long term). To the researcher's knowledge, this weighting strategy has not been used in other studies.

[73] [http://www.statistics.gov.uk/StatBase/tsdataset.asp?vlnk=229&More=N&All=Y]

latter intention, to a reasonable extent, has captured the savings for any short-term uncertainty. In order to distinguish the short-term savings for things needed now from those for unexpected events, this work assumed that the savings for things needed now contained certainty and were known to the savers when they commenced the saving. Hence, this assumption granted the possibility that the latter savings played the role as precautionary savings which may vary according to the uncertainty in the near-term future.

The saving motives in the first stage represented only the saving preferences of the heads of households; by contrast, the estimated savings amount in this stage took into account saving preferences of every individual's saving decisions in a given household. In this stage, the change in the long-term saving ratio and short-term saving ratio were examined, with respect to the subjective uncertainty and other crucial factors, based on a similar framework in the first stage. The dependent variable is the (measured) savings amount to permanent income[74] ratio, and is named saving ratios hereafter - long-term saving ratio and short-term saving ratio, respectively.

3.2.1.3 Saving amounts

In the third stage analysis, the savings amount - long-term and short-term, respectively - imputed earlier took the role of the dependent variable in the regression analysis on the relationship between households' savings amount and age structure.

3.2.2 Construction of independent variables

3.2.2.1 Financial expectation, current status, and realisation

Financial expectations [75] play the role of the proxy for uncertainty of the individuals/households in the short term. The individuals were surveyed about their financial expectation in the next twelve months:

'*Looking ahead, how do you think you will be financially a year from now, will you be 'better than now* (recoded as '1')', *'about the same* (recoded as '2')', *'worse than now*

[74] The estimation method of the permanent income is to be explained in the next section.

[75] In Guariglia (2001), this variable played the role as a control variable but not a proxy indicator for the household's income uncertainty.

(recoded as '3')', *'missing or wild* (coded as '-9')', *'proxy respondent* (coded as '-7')', *or 'don't know* (coded as '-1')' .[76]

Following the concept applied in Murata (2003), if the individual expected to be financially worse-off 12 months later, he/she, at that moment, had the expectation of shocks on financial status, and that consumption would be at a risk of decreasing. Future risk here is specified as subjectively-perceived risk, indicating households' perception that their future needs/goals would be under threat (Wärneryd, 1999). As reviewed in the section on the proxy of uncertainty, this way of defining future risk is rarely used by economists as it provides only a limited explicit numerical estimation on income variability or possibility distribution of occurrences of future situations. However, it does provide a more psychologically driven sense of risk; as proposed in Stone and Winter (1987), risk was defined as *a subjectively-determined expectation of loss*; the more certain one is about the expectation, the more risk he/she has. This idea has widely applied in the field of consumer behaviour (Lim, 2003; Cunningham, Gerlach, Harper, and Young, 2005). Accordingly, households who expect to have a worse-off financial situation are considered to perceive higher risk, than those who expect to have a better-off financial situation and those who expect things to remain the same.

Moreover, the uncertainty/risk here does not point to a single type of risk, but can be attributed to the possibility of becoming unemployed, the possibility of requiring higher health expenditure, or any other type of risk that would have a negative impact on the individual's finances. The subjective expectation of financial status may not have captured the *ex post* facts that happen in a year due to possible expectation error. However, it is proposed here that the households normally rely on their subjectively-perceived anticipation for the decisions to be made today, instead of on the actual realisation that hasn't taken place until one year later. Thus, the expectation of the financial situation over the next 12 months was employed as the proxy for short-term uncertainty/risk. The relationship between the short-term uncertainty/risk and saving motives will be examined in accordance with the buffer-stock model. At the whole sample level, 31.8% of observations perceived that they had a better-off financial

[76] Response observations of 'missing or wild', 'proxy respondent', or 'don't know' were considered invalid observations in this study. This is also the case for financial realizations as well as current financial situations to be mentioned below.

situation, and only 7.3% of observations perceived that they had a worse-off one; over half of the households perceived their financial situation in the near future would remain the same.

In addition, the individuals were surveyed about their changes in financial situation during the past 12 months, i.e. financial realisation, and their current financial status, which were considered influential in households' saving motives. The individuals were asked:

'*Would you say that you yourself are better off or worse off financially than you were a year ago? 'Better off than last year'* (coded as '1'), *' about the same'* (recoded as '2'), *'worse-off than last year'* (recoded as '3'), *'missing or wild* (coded as '-9')', *'proxy respondent* (coded as '-7')', or *'don't know* (coded as '-1')'.

The change of financial position during the last year, called financial realisation hereafter, aims to captures the effect of recent financial experience, in comparison with present status. 39.7% of the valid observations reported as having a better-off financial realisation, referring to the fact that these households perceived their financial situations as having improved since the previous year. 14.2% of observations reported to have worse-off financial realisation, meaning that these households considered that their financial situations had got weaker. Regarding current financial status, the individuals were asked:

'*How well would you say you yourself are managing financially these days? 'Living comfortably / doing all right'* (recoded as '1'), *'just about getting by'* (recoded as '2'), *'finding it quite difficult / finding it very difficult'* (recoded as '3'), *'missing or wild* (coded as '-9')', *'proxy respondent* (coded as '-7')', or *'don't know* (coded as '-1')'.

84.9% of the valid observations responded that in their current financial situation they were living comfortably or doing all right. Only 1.7% of the observations stated that their financial situation was quite difficult or very difficult. In sum, most of the sample observations had a positive, or at least neutral, current financial situation.

3.2.2.2 Homeownership and private pension enrolment

Two proxy variables are presented below, representing respectively, whether the households owned housing wealth and whether the households regularly paid into private pension schemes. Both those who had a mortgage or owned their houses

outright were considered as being homeowners. In this study, homeownership plays the role of a proxy for the possession of illiquid assets, and housing wealth is considered to be part of homeowners' long-term savings; private pension enrolment as a proxy for the household's willingness to commitment themselves to an external mechanism, which aims to help them save for retirement. The application of the proxies for the illiquid assets holding and the external commitment scheme is derived from the implication of the quasi-hyperbolic consumption life-cycle model, which posits that the consumers with inconsistent time preference prefer to save money in illiquid forms or take up a savings commitment to tackle their self-control problems.

Both housing wealth and pension wealth are illiquid wealth and they provide the household with constraints on instant liquidity. Having said so, there still exists a difference between the two types of wealth. Housing wealth can be collaterallable, which can provide liquidity for those homeowners whenever needed; on the other hand, households do not have access to their pension wealth until they retire. In terms of goals for savings, households' paying into a private pension explicitly indicates that they have taken action to save primarily for retirement; by contrast, accumulating housing wealth is considered to be saving as a consequence of various incentives: saving for the long term, the intention of saving regularly by paying a mortgage (self-imposed saving commitment), or bequeathing to heirs. It was found that 86.4% of the total valid sample observations owned a property, and 27% had joined a private pension scheme.

3.2.2.3 Habit effects[77]

The individuals who save were also surveyed about their first reason for saving. They were asked:

- *'What are you saving for?'*

The listed reasons cover 'holidays', 'old age', 'car', 'children', 'house purchases', 'home improvement', 'household bills', 'special events', 'no specific reason', 'share schemes', 'own education', 'grandchild', and 'other'. The motive of 'no specific reason' is considered as a habitual effect; this can suggest the influence of an endowment effect, suggesting that households develop a routine/rule on their saving decisions, and they are resistant to changing it. Moreover, savings for no specific reason are likely to be an

[77] Note that this variable is considered only in the savings ratio analysis.

outcome of households' controlling expenditure (Wärneryd, 1999). In order to investigate such an effect, the households were grouped into two: one group contained those who have clearly specified their main reason for saving, and the other included those who saved for no specific reason. Hence a dummy indicator was generated to represent the latter group.

3.2.2.4 Permanent income

Estimated household permanent income is suggested as a proxy indicator for the household wealth level. (Guariglia, 2001) The concept of permanent income comes from Milton Friedman's *permanent income hypothesis*. Permanent income is determined by a consumer's assets: physical (shares, bonds, property) and human (education and experience). These influence the consumer's ability to earn income. The measured income contains a permanent (anticipated and planned) element and a transitory (windfall gain/unexpected) element.

First, the measurement of the total household available income, which includes the labour income, transfer income, and investment income, is required for permanent income estimation. The estimated permanent income was obtained by regressing, based on a random-effect model, the log of the household's observed total annual income[78] on the observable characteristics of the heads of the households. The observed characteristics included: gender, age, age-square, educational level dummies, occupation dummies, interaction of the age and the age-square with the educational level dummies and the occupation dummies - age × education dummies, age × occupation dummies, age^2 × education dummies, and age^2 × occupation dummies -, residence area dummies, marital status, number of children in the household, whether the heads of household have spouse/partner in employment, and the homeownership dummy. (Kazarosian, 1997; Guariglia, 2001; Carroll, Dynan, and Krane 2003; Benito, 2004)

[78] Annual income is deflated according to the index numbers of September of each year of the monthly Retail Price Index (RPI). Index number of January 1987=100.
[http://www.statistics.gov.uk/StatBase/tsdataset.asp?vlnk=229&More=N&All=Y]

3.2.2.5 Other control variables

The following outlines the set of the geographic characteristic, socio-economic features, and life-cycle factors of the households. The geographic characteristic refers to the residential area. The life-cycle factors include the age[79] of the heads of the households, family size, and whether the households have children. The sample included only the heads of the households who were aged between 25 and 65, and the age effect mainly captured the life-cycle effect.

Socioeconomic features were considered to have a significant influence on savings behaviour. For instance, highly educated people may carry out precautionary saving behaviour better than those with the lower educational attainment levels. The socio-economic features considered in this work took into account: gender, occupation types, educational level, employment status (self-employed/employee), full-time/part-time job, marital status and whether the partner was employed or not if the head of the households had a partner.

The occupational indicators, educational level indicators, and the residential area indicators were rearranged and recoded. The new indicators for the occupation dummies, the education dummies, and the residence area dummies against the old ones are reported in Tables A.1- Table A.3 in Section A in the Appendices.

3.3 SAMPLE DESCRIPTION AND DATA ANALYSIS

3.3.1 Analysis of saving motives

3.3.1.1 Sample description

The final sample selected for the first-stage analysis had 7763 effective observations in total out of four waves - wave 10 to wave 13, forming an *unbalanced panel* dataset. Respectively, 1923 observations were from wave 10, 1999 observations from wave 11, 1945 observations from wave 12, and 1896 observations from wave 13. A sample where the individuals are observed over the entire sample period is a balanced or a complete panel, whereas a sample where some of the individuals are observed only over a partial

[79] In the econometric analysis, the value of age-square is included as well as it captures the non-linearity between age and the ratio of wealth to permanent income.

period is an incomplete or an unbalanced panel. Incomplete panels are more likely to be the norm in the typical economic empirical setting; for example, whilst using consumer panels on households, one may find that some households have moved and can no longer be included in the panel (Baltagi, 2001).

Advantages of using a panel data in this study are as follows (Baltagi, 2001). Firstly, unobserved heterogeneity of households can be controlled in a panel-data estimation method, through a random-effect or fixed-effect specification; meanwhile, business-cycle effects (time-effects) can be disentangled, e.g. an exogenous macroeconomic shock occurring in a specific year has an impact on households' saving/consumption decisions. Secondly, panel data is better able to identify and measure effects that are simply not detectable in pure cross-section or time-series data. For instance, suppose that there is a cross-section of households with a 50% average labour participation rate. This might be due to a) each household having a 50% chance of being in the labour force, or b) 50% of the households working all the time and 50% not at all. Panel data can discriminate between these cases. Thirdly, panel data are better able to study the dynamics of changes. This allows for the saving behaviour of a household to be observed over time. Fourthly, a panel data gives more variability, less collinearity amongst the variables, more degrees of freedom and more efficiency.

The whole sample was disaggregated by homeownership and private pension enrolment into two sub-samples: homeowners and private pension participants. The size of each of the sub-samples is shown in Table 3.1 below. Putting homeowners and private pension participants into comparison shows the effects of two distinct external commitment mechanisms to long-term savings – homeownership and private pension enrolment. The quasi-hyperbolic consumption model posits that housing wealth is illiquid savings for the long term, as it does not serve as instant liquidity and households are unlikely to splurge with it. In addition housing wealth can be collateralised to finance households' difficulties in the long-term future. As also suggested by the behavioural models, a household's participation in a private pension schemes suggests it is saving for retirement, by committing itself to a regular saving scheme. In contrast to housing wealth, pension wealth can be only accessed after a household's retirement and thus generates no liquidity beforehand.

In the previous section, the sample size attributed to each cross-sectional dataset has been stated as: 1923 observations in wave 10, 1999 observations in wave 11, 1945 observations in wave 12, and 1896 in wave 13. Similarly, each cross-sectional dataset was disaggregated into two sub-samples using the criteria of homeownership and private pension enrolment. The sample sizes of each cross-sectional dataset and sub-samples are also shown in Table 3.1 below.

Table 3.1: Sample size of the whole sample and two sub-groups by waves

Sample / *Wave*	*Homeowners*	*Private pension participants*	**Whole sample**
10	1631	540	1923
11	1718	539	1999
12	1709	542	1945
13	1646	477	1896
Total waves	6704	2098	7763

3.3.1.2 Data analysis

To begin with, simple descriptive analysis of saving motives as the dependent variable is demonstrated. Table 3.2 illustrates the shares of the three types of saving motives – mainly long-term, mainly short-term savers, and both equally - across the four waves of the whole samples and the sub-samples. At the whole sample level, the shares of the households reporting to save mainly for the long term are generally higher than those of the households reporting to save mainly for the short term. The trends of the shares across the four waves are depicted in Figure 3-1. As shown in the figure, the trend of saving mainly for the short term remains relatively flat across the four waves; the trend of saving mainly for long term starts to go downward and the trend of saving for both equally starts to go upward between wave 11 (year 2001-2002) and wave 13 (year 2003-2004). Thus, the gap between these two trends is narrowing down over time.

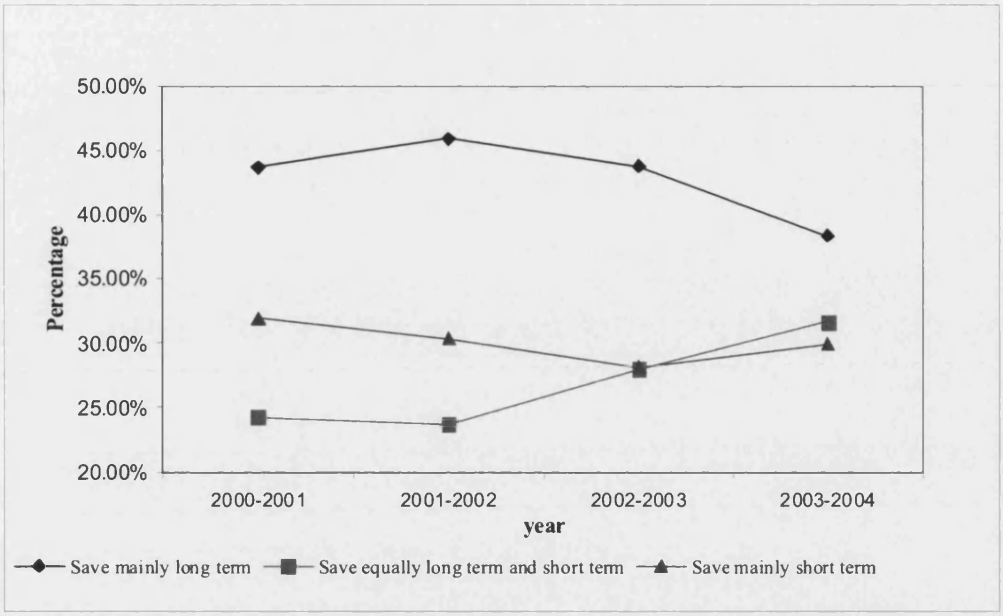

Figure 3-1: Saving motives at the whole sample level

Table 3.2 shows that the shares of the long-term savers of the private pension participants are slightly higher than those of the homeowners. Figure 3-2 exhibits the trend of the shares of pension participants' three types of savers across the four waves and Figure 3-4 the same for the homeowners. Both figures generally show a similar profile to the whole sample, in the sense that the shares of the short-term savers remain relatively stable at a lower level, whilst increasing shares of savers for both equally make up for the decreasing shares of the long-term savers between wave 11 (year 2001-2002) and wave 13 (year 2003-2004).

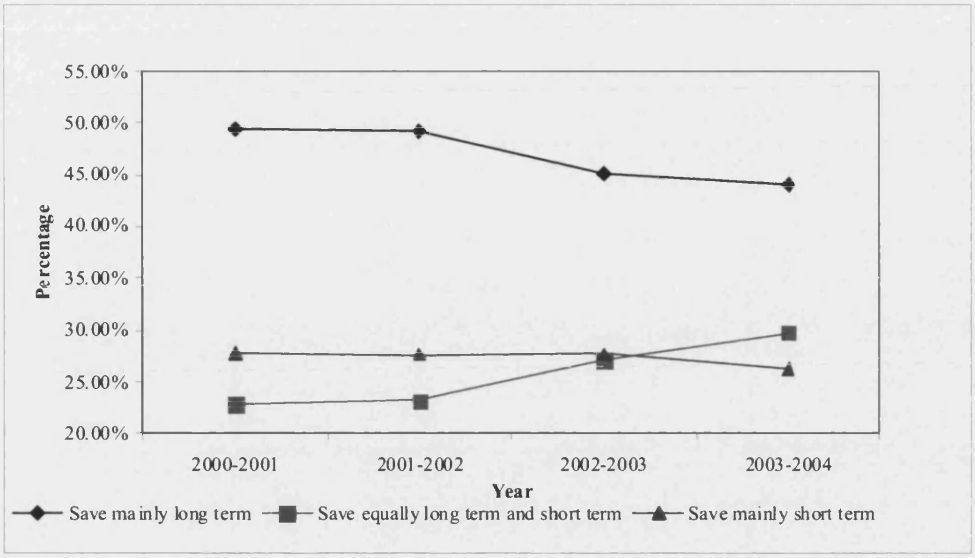

Figure 3-3: Private pension participants' saving motives

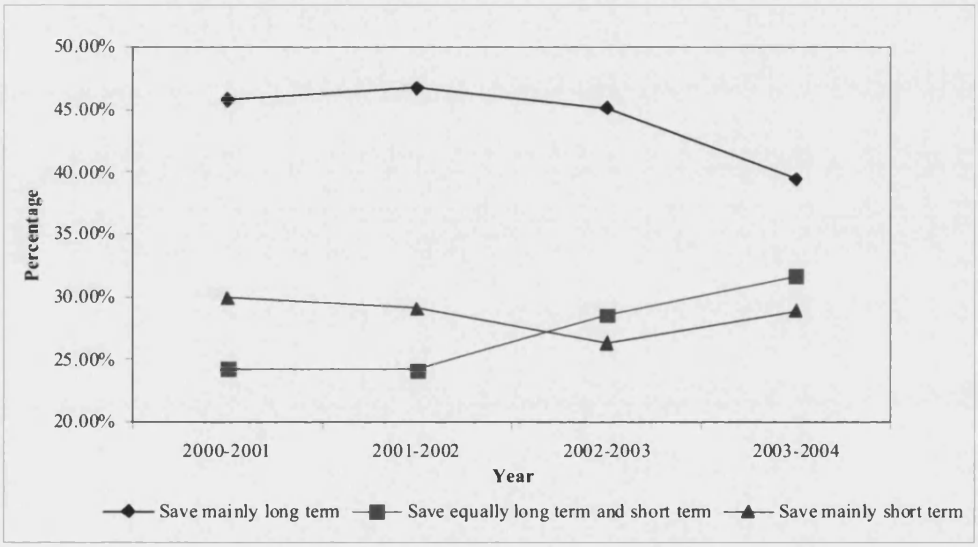

Figure 3-4: Homeowners' saving motives

Table 3.2: Shares of three types of savers across the four waves

	Number of observations	Save mainly long term				Save equally long term and short term				Save mainly short term			
		2000-2001	2001-2002	2002-2003	2003-2004	2000-2001	2001-2002	2002-2003	2003-2004	2000-2001	2001-2002	2002-2003	2003-2004
Whole sample	7763	43.73%	45.92%	43.80%	38.40%	24.28%	23.71%	28.02%	31.65%	31.98%	30.37%	28.17%	29.96%
Homeowner	6704	45.80%	46.74%	45.11%	39.49%	24.28%	24.16%	28.55%	31.65%	29.92%	29.10%	26.33%	28.86%
Pension participants	2098	49.44%	49.17%	45.20%	44.03%	22.78%	23.19%	27.12%	29.77%	27.78%	27.64%	27.68%	26.21%

The short-term uncertainty/risk is captured by the proxy indicator of the households' subjective financial expectation. In Table 3.3, it is shown that over 40% of the sample, regardless of whether they have a positive, negative, or neutral financial expectation, have mainly a long-term saving motive, and the percentage is the highest amongst those who have a negative financial expectation. The share of saving mainly for the short term is the highest amongst those who perceive that they will experience negative shocks in the next 12 months. The indicator of financial realisation captures the effect of previous financial experience on the saving motives. As shown in the fifth row of Table 3.4, the shares of the observations with mainly short-term saving motive are monotonically increasing when the current situation is worse than the previous year. Table 3.5 exhibits the profile of saving motives against current financial status. Two trends can be observed: as the current financial status gets worse, the shares of the observations with mainly short-term saving motive are increasing and the shares of those with both saving motives are decreasing.

Table 3.3: The percentage three types of savers by three types of financial expectation at the whole sample level

	Financial expectation		
Saving motive	Better off	About the same	Worse off
Mainly long term	43.45%	42.59%	44.64%
Both equally	26.17%	27.81%	22.14%
Mainly short term	30.39%	29.60%	33.22%
	100%	100%	100%

Table 3.4: The percentage three types of savers by three types of financial realisation at the whole sample level

	Financial realisation		
Saving motive	Better than last year	About the same	Worse than last year
Mainly long term	42.98%	42.22%	45.65%
Both equally	27.23%	27.73%	23.10%
Mainly short term	29.79%	30.05%	31.25%
	100%	100%	100%

Table 3.5: The percentage three types of savers by three types of current financial status at the whole sample level

	Current financial status		
Saving motive	Doing alright or well	Just getting by	Finding it difficult
Mainly long term	43.77%	38.31%	42.31%
Both equally	28.15%	20.59%	12.31%
Mainly short term	28.08%	41.09%	45.38%
	100%	100%	100%

Homeownership is an indicator for the holding of illiquid assets. Table 3.6 illustrates the association between homeownership and saving motives. It is clearly shown that the proportion of the homeowners who engage in mainly long-term saving is higher than that of non-homeowners; on the other hand, the share of the non-homeowners who save mainly for the short term is significantly higher, than that of the homeowners. The households who have paid into a private pension scheme are considered as having committed themselves to an external mechanism, in order to save for the retirement. In Table 3.7, it can be seen that more people with a private pension save mainly for the long term than those who don't have one, whereas fewer save mainly for short term than non-pension participants.

Table 3.6: Three types of savers by with/without homeownership at the whole sample level

	Homeownership	
Saving motive	Homeowner	Non-homeowner
Mainly long term	44.32%	34.75%
Both equally	27.15%	25.12%
Mainly short term	28.54%	40.13%
	100%	100%

Table 3.7: Three types of savers by with/without pension enrolment at the whole sample level

	Pension enrolment	
Saving motive	Pensioners	Non-pensioners
Mainly long term	47.04%	41.52%
Both equally	25.60%	27.34%
Mainly short term	27.36%	31.14%
	100%	100%

With the consideration that the households who owned a property would feel less liquidity constrained and thus feel more positive with their financial expectations, a simple cross tabulation was applied on homeowners and non-homeowners with respect to their financial expectation. In Table 3.8, the third column shows that a higher proportion of the homeowners than of the non-homeowners have neutral financial expectations (61.55% against 56.94%). Moreover, the share of the observations with worse-off expectations is higher amongst the homeowners than amongst the non-homeowners, and the share of those with better-off expectations is smaller amongst the homeowners than amongst the non-homeowners. Table 3.9 exhibits the breakdown of homeownership against financial realisation. Whilst the proportion of the observations with neutral financial realisations is larger amongst the homeowners than amongst the non-homeowners, the share of the observations with a situation better than last year is

lower amongst homeowners than amongst their counterparts. Conversely, the share of the observations with a situation worse than last year is higher amongst the homeowners than amongst non-homeowners. The classification of homeownership against the current financial situations is displayed in Table 3.10. It is observed that the vast majority of both homeowners and non-homeowners have a satisfactory current financial status, and only less than 4% of them find themselves in a difficult situation.

Table 3.8: The share of homeowners/non-homeowners by three types of financial expectation

	Financial expectation			
Home ownership	Better off	About the same	Worse off	
Homeowners	30.83%	61.55%	7.62%	100%
Non-homeowners	37.58%	56.94%	5.48%	100%

Table 3.9: The share of homeowners/non-homeowners by three types of financial realisation

	Financial realisation			
Home ownership	Better than last year	About the same	Worse than last year	
Homeowners	38.62%	46.87%	14.51%	100%
Non-homeowners	46.18%	41.45%	12.37%	100%

Table 3.10: The share of homeowners/non-homeowners by three types of current financial status

	Current financial status			
Home ownership	Doing alright or well	Just getting by	Finding it difficult	
Homeowners	86.31%	12.23%	1.46%	100%
Non-homeowners	75.83%	21.15%	3.02%	100%

3.3.2 Analysis of saving ratios

3.3.2.1 Sample description

The sample was selected by similar criteria to those applied in the first stage. The observations with the estimated saving ratio above one were filtered out of the sample[80]in that it distorted the sample distribution. In total, there were 7197 effective observations, representing 3561 households in total across the four waves, forming an unbalanced panel dataset. Respectively, there were 1705 observations in wave 10, 1958 observations in wave 11, 1781 observations in wave 12, and 1753 observations in wave 13. The whole sample was also disaggregated by homeownership and private pension enrolment into two sub-samples: homeowners and private pensioner participants. The size of each sub-sample is reported in Table 3.11 below.

[80] There are 6 observations with savings ratio above one.

Table 3.11: Sample size for each wave by sub-samples

Sample / Wave	*Homeowners*	*Private pension participants*	**Total sample**
10	1445	460	1705
11	1679	525	1958
12	1561	481	1781
13	1520	433	1753

3.3.2.2 Data analysis

Table 3.12 below provides descriptive statistics of the imputed short-term and long-term saving ratio. The mean values overall are above the median values, that is, the sample dataset is right-skewed. The short-term saving ratios range from 3.8% to 4.2% and the long-term saving ratios are located between 5.2% and 5.8%.

Table 3.12: Descriptive statistics of the imputed long-term saving ratio and short-term saving ratio by waves

Saving ratio	*Mean*	*Std. Deviation*	*Median*	*1st quartile*	*3rd quartile*
Short term saving ratio (%)					
Wave 10	3.8	5.9	1.9	0	5.2
Wave 11	4.0	6.6	2.1	0	5.3
Wave 12	3.8	5.6	2.1	0	5.3
Wave13	4.2	6.3	2.4	0	5.8
Long term saving ratio (%)					
Wave 10	5.3	7.6	3.0	0	7.1
Wave 11	5.5	7.3	3.3	0	7.4
Wave 12	5.8	8.1	3.2	0.6	7.4
Wave 13	5.2	7.4	3.0	0.3	6.7

Table 3.13 reports the descriptive statistics of each sub-sample. In comparison to the panel of the short-term saving ratios, the long-term saving ratios are generally higher than the short-term saving ratios. Of the two groups, pension participants, on average, have a higher saving ratio – long-term and short-term – than homeowners.

Table 3.13: Descriptive statistics of two types of saving ratio by sub-samples

	Mean	Std deviation	Median	1st quartile	3rd quartile
Long-term saving ratio (%)					
Homeowners	5.5	7.5	3.3	0.6	7.1
Private pension participants	6.4	9.1	3.6	0.9	8.3
Short-term saving ratio (%)					
Homeowners	3.8	5.8	2.1	0	5.3
Private pension participants	4.0	6.6	1.9	0	5.2

The mean figures of the saving ratios by financial situations are exhibited in Table 3.14. The short-term average saving ratios and the long-term saving ratios do not vary much with financial expectations. Hence this provides little evidence that households' saving ratios, long-term or short-term, are significantly influenced by short-term uncertainty. In contrast, the difference between the financial situation now and a year ago appears to be associated monotonically. Compared with the previous year, a better-off financial realisation tends to be related to a higher short-term saving ratio and higher long-term saving ratio, and vice versa. Similarly, the households have higher long-term saving ratio and short-term saving ratio whilst their current financial situations are positive. Comparing the two types of saving ratios, it is obvious that the long-term saving ratios are generally above the short-term ones, but the exception occurs amongst the households that are having financial difficulties, as they tend to save more for the short term than for the long term and hence the gap between the two saving ratios is narrower.

Table 3.14: The mean of two types of saving ratio against financial expectations, financial realisations, and current financial status

	Short-term saving ratio (%)	*Long-term saving ratio (%)*
Financial expectation		
Better off	4.1	5.5
About the same	3.9	5.4
Worse off	4.0	5.4
Financial realisation		
Better than last year	4.4	6.0
About the same	3.8	5.3
Worse than last year	3.2	4.5
Current financial status		
Doing well or alright	4.0	5.9
Just getting by	3.4	3.3
Finding it difficult	3.5	2.1

Table 3.15 shows that the average short-term saving ratio of homeowners is lower than that of non-homeowners, whereas the average long-term saving ratio of homeowners is higher than that of non-homeowners. Whilst it is observed in both groups that the long-term saving ratios are higher than the short-term saving ratio, the gap between the two types of saving ratio appears to be bigger for homeowners than for non-homeowners. This may be due to homeowners having a preference for long-term saving over short-term saving. The average short-term saving ratio of pension-participants is similar to that of non pension-participants. However, the average long-term saving ratio of pension-participants appears to be higher than that of their counterparts. This may

indicate that whilst the households have paid into private pension schemes to guarantee consumption after retirement, they have also managed to build up more discretionary long-term savings than their counterparts.

Table 3.15: The mean of two types of saving ratio against with/without homeownership and with/without pension enrolment

	Short-term saving ratio (%)	*Long-term saving ratio (%)*
Homeownership		
Homeowners	3.8	5.5
Non-homeowners	4.9	5.1
Pension enrolment		
Pension-participants	4.0	6.4
Non pension-participants	3.9	5.1

3.3.3 Analysis of saving amounts

3.3.3.1 Sample description

In the third stage analysis, the savings amount took the role of the dependent variable as the distribution of the savings amount against age was examined. In addition to the whole sample and sub-groups of homeowners and private pension participants, three additional sub-groups were considered: males, females, and employees. Separating males and females was as a result of previous findings in the first and the second stages which have suggested that gender difference plays a robust role in determining households' saving preferences. Moreover, the self-employed are distinct from employees in that they are more financially vulnerable as their social security welfare are less guaranteed. In addition, the self-employed can be considered as both private persons and enterprises, and entrepreneurs tend to save, on average, a larger proportion of their income than other people with similar incomes and have a unique and apparently powerful motive to save (Katona, 1960). Therefore, in this study, the employees group is taken as a subgroup in this study[81]. Valid samples are reported in Table 3.16 below.

[81] Owing to the small sample sizes of the self-employed group over the four waves, their savings-age profiles are not able to be estimated from the estimation method chosen.

Table 3.16: Sample size for each wave by sub-samples

Sample / Wave	*Males*	*Females*	*Homeowners*	*Pensioners*	*Self-employed*	*Employees*	**Total sample**
10	1316	389	1445	460	165	1540	1705
11	1516	442	1679	525	218	1740	1958
12	1396	385	1561	481	195	1586	1781
13	1363	390	1520	433	200	1553	1753

3.3.3.2 Data analysis

In an attempt to classify the effect of inconsistent time preference on the households' savings-age profiles, this work intended to explore the short-term savings and long-term savings distributions throughout the working life cycle, between age 25 and age 65. The reason for confining the age range of the sample between 25 and 65 was to ensure that there was consistency in the sample throughout the three stages. The descriptive statistics of the savings amount are reported in Table 3.17. As shown, long-term savings are well above short-term savings in all four waves, and this implies that the households generally put away more money for future use than for short-term purposes.

Table 3.17: Descriptive statistics of the short-term savings and long-term savings by wave (year £ in September 2000 prices)

Savings amount	***Mean***	***Std. Deviation***	***Median***	***1st quartile***	***3rd quartile***
Short term savings					
Wave 10	1172.26	1849.81	600	0	1500
Wave 11	1250.03	2288.06	590.03	0	1534.09
Wave 12	1225.74	2023.16	580.07	0	1740.2
Wave13	1401.61	2279.82	564.49	0	1693.48
Long term savings					
Wave 10	1882.61	3031.73	900	0	2400
Wave 11	1986.6	3303.36	1032.56	0	2360.14
Wave 12	2087.57	3354.67	1160.14	174.02	2436.28
Wave 13	1982.11	3831.35	903.19	112.9	2257.97

Table 3.18 displays the descriptive statistics of total savings and their breakdown into long-term savings and short-term savings. It is observed across all the four waves and across all the sub-samples, that the long-term savings amount considerably exceeds the short-term savings amount. This demonstrates that households put away more resources for the long run than for short-term purposes. The table below shows that, on average, the self-employed save more, for both the long term and the short term than employees. Male households have both higher long-term savings and short-term savings than

female ones. Comparing homeowners with pension-participants, both have accumulated illiquid assets, but pension-participants, on average, have higher discretionary savings both for the long term and the short term.

Table 3.18: The descriptive statistics of savings amount by waves and by sub-samples (year £ in September 2000 prices)

	Mean	*Std deviation*	*Median*	*1st quartile*	*3rd quartile*
Wave 10					
Total savings					
Males	3376.11	3789.16	2400	1200	4200
Females	1968.06	2491.94	1200	600	2400
Homeowners	3226.98	3735.43	2220	1200	4080
Private pension participants	3257.27	3793.4	2160	1080	4140
Employees	2908.36	3341.17	1800	960	3600
Self-employed[82]	4422.26	5157.9	2880	1200	5400
Short-term savings					
Males	1279.04	1991.74	600	0	1800
Females	811	1188.8	360	0	1200
Homeowners	1197.72	1859.28	600	0	1800
Private pension participants	1160.86	1939.58	600	0	1665
Employees	1170.96	1841.87	600	0	1500
Self-employed	1184.33	1928.05	360	0	1500
Long-term savings					
Males	2097.07	3220.51	1200	180	2610
Females	1157.06	2128.65	420	0	1200
Homeowners	2029.26	3198.82	960	120	2400
Private pension participants	2096.41	3382.83	1104	180	2610
Employees	1737.39	2727.9	900	0	2400
Self-employed	3237.93	4860.4	1500	600	3600
Wave 11					
Total savings					
Males	3524.43	4155.79	2360.14	1180.07	4130.24
Females	2249.5	4043.63	1180.07	590.03	2478.14
Homeowners	3391.08	4320.24	2360.14	1180.07	4130.24
Private pension participants	3646.73	4990.25	2360.14	1180.07	4130.24
Employees	3057.82	3514.22	2065.12	1180.07	3540.21
Self-employed	4663.76	7422.79	2360.14	1180.07	4720.27
Short-term savings					
Males	1328.82	2443.67	590.03	0	1770.1
Females	979.8	1619.58	590.03	0	1180.07
Homeowners	1295.563	2385.52	590.03	0	1652.1
Private pension participants	1335.94	2562.84	590.03	0	1770.1
Employees	1154.38	1765.17	590.03	0	1475.09
Self-employed	2013.48	4645.94	590.03	0	1770.1
Long-term savings					

[82] The self-employed is not a subgroup.

Males	2195.61	3234.86	1180.07	236.01	2950.17
Females	1269.7	3436.61	472.03	0	1180.07
Homeowners	2095.51	3414.23	1180.07	177.01	2360.14
Private pension participants	2310.79	4066.52	1180.07	236.01	2761.36
Employees	1903.44	2966.66	944.05	0	2360.14
Self-employed	2650.28	5232.86	1180.07	236.01	2950.17
Wave 12					
Total savings					
Males	3632.16	4203.99	2320.27	1160.14	4640.54
Females	2157.13	2620.83	1160.14	580.07	2320.27
Homeowners	3449.64	4085.11	2320.27	1160.14	4292.5
Private pension participants	3938.62	5091.32	2320.27	1160.14	4640.54
Employees	3219.96	3885.31	2320.27	1160.14	4060.47
Self-employed	4072.49	4481.38	2529.1	1160.14	5800.68
Short-term savings					
Males	1339.36	2178.03	580.07	0	1740.2
Females	813.75	1234.13	464.05	0	1160.14
Homeowners	1252.38	2072.62	580.07	0	1740.2
Private pension participants	1376.51	2663.14	580.07	0	1740.2
Employees	1201.3	1957.93	580.07	0	1740.2
Self-employed	1424.47	2488.23	580.07	0	1740.2
Long-term savings					
Males	2292.81	3527.34	1160.14	290.03	2900.34
Females	1343.38	2501.59	580.07	0	1450.17
Homeowners	2197.26	3457.24	1160.14	232.03	2610.31
Private pension participants	2562.11	4299.38	1160.14	232.03	2900.34
Employees	2018.66	3290.22	1160.14	116.01	2320.27
Self-employed	2648.02	3802.14	1160.14	464.05	3480.41
Wave 13					
Total savings					
Males	3766.29	4827.62	2257.97	1128.99	4515.95
Females	2046.68	3208.33	1128.99	564.49	2257.97
Homeowners	3540.84	4771.17	2257.97	1128.99	4515.95
Private pension participants	4286.84	6372.34	2257.97	1128.99	4515.95
Employees	3250.6	4301.78	2257.97	1128.99	3951.45
Self-employed	4417.39	6213.14	2263.62	1128.99	4515.95
Short-term savings					
Males	1541.79	2483.25	790.29	0	2088.63
Females	911.69	1228.38	564.49	0	1128.99
Homeowners	1437.55	2340.37	677.392	0	1707.59
Private pension participants	1589.71	2757.2	677.39	0	1862.83
Employees	1357.31	2063.3	564.49	0	1693.48
Self-employed	1745.53	3524.72	677.39	0	2257.97
Long-term savings					
Males	2224.5	4022.04	1128.99	225.8	2596.67
Females	1134.99	2923.71	451.59	0	1128.99
Homeowners	2103.3	4025.4	1128.99	169.35	2257.97
Private pension participants	2697.13	5619.02	1128.99	282.25	2709.57

Employees	1893.28	3621.32	846.74	56.45	2257.97
Self-employed	2671.86	5140.1	1128.99	282.25	2822.47

A preliminary investigation of the savings profiles against the age cohorts was carried out, and the results are exhibited in Table 3.19. It is evident that across the four waves, the long-term savings are at their lowest level during young working age, and increase afterwards. A similar trend can be found in total savings of waves 10, 11, and 12 with wave 13 being the exception. In wave 13, the total savings median of the households whose heads are aged between 35 and 44 appears to be the lowest, and this can be attributed to a macroeconomic effect occurring in that year or to sample selection. In general, the short-term savings of the four waves do not present a pattern of increase or decrease with age; in addition, the medians of the short-term savings remain consistent or only vary moderately across the age groups. However, in wave 13, the short-term savings increase between age 25 and 44, and decrease afterwards; this shows itself as a small hump shape.

Table 3.19: The median savings amount of a give age range (year £ in September 2000 prices)

	Total savings	*Short-term savings*	*Long-term savings*
Wave 10			
Age 25 to 34	1800	600	660
Age 35 to 44	1800	540	600
Age 45 to 54	2400	600	1200
Age 55 to 65	2400	450	1200
Wave 11			
Age 25 to 34	1770.1	590.03	604.79
Age 35 to 44	1888.11	590.03	944.05
Age 45 to 54	2360.14	590.03	1180.07
Age 55 to 65	2360.14	472.03	1180.07
Wave 12			
Age 25 to 34	1972.23	580.07	870.1
Age 35 to 44	2320.27	580.07	1160.14
Age 45 to 54	2320.27	580.07	1160.14
Age 55 to 65	2320.27	580.07	1160.14
Wave 13			
Age 25 to 34	2257.97	564.49	592.72
Age 35 to 44	2145.08	677.39	852.39
Age 45 to 54	2257.97	620.94	1128.99
Age 55 to 65	2257.97	564.49	1128.99

3.4 CONCLUSION

In the first stage, of the whole sample and of the sub-samples: homeowners and private pension participants, it is shown that, in general, around 40% to 45% of the observations have been reported as saving mainly for the long term. This demonstrates that a significant portion of households mainly engage in long-term savings. In the second stage, the short-term saving ratios range from 3.8 % to 4.2 % and the long-term saving ratios from 5.2 % to 5.8 %. In the third stage, it is found throughout the four waves and across all the sub-samples[83], that the long-term savings amount considerably exceeds the short-term savings amount. In addition, the self-employed save more for both long-term and short term than employees; male households have higher long-term and short-term savings than female households; pension-participants, on average, have higher savings both for long-term and short-term purposes than homeowners.

Next, the relationships between the dependent variables and the independent variables were also examined. The effects of the financial realisations and of the current financial status are more evident as influences on the saving motives than the effects of financial expectations. Nevertheless, it is still observed that, of the households saving mainly for the short term, the share of those with a worse-off expectation is slightly higher than those with a better-off expectation. This suggests that the households who save mainly for the short term, to some extent, tend to identify with negative shocks. The percentage of mainly short-term savers of the non-homeowners lies significantly above that of the homeowners, and the share of the mainly long-term savers of homeowners is larger than that of non-homeowners. This implies that homeowners are more inclined to save discretionarily for the long term and less inclined to save for the short term than non-homeowners. A similar pattern can be observed amongst pension participants and their counterparts. Nevertheless, comparing these two groups, the gap between the shares of either the long-term savers or of the short-term savers, is relatively small.

It is shown that the short-term average saving ratios and the long-term saving ratios do not vary much with financial expectations, whilst the effects of the financial realisations and current financial situations are evident. The effect of homeownership is reflected in

[83] In the third stage, sub-samples include males, females, homeowners, private pension participants, and employees.

both the long-term saving ratio and the short-term saving ratio, whereas pension enrolment only makes a difference on the long-term saving ratio.

Regarding the association between the savings amount and the age cohorts, it is evident that the long-term savings are at their lowest level during young working age, and increase afterwards. However, the medians of the short-term savings remain consistent or only vary moderately across the age groups. Hence, the preliminary findings suggest that the age effect appears to be more significant on long-term savings than on short-term savings.

Having summarised the findings from the descriptive statistics, econometric analytical tools will be employed to examine the association of the saving motives, the saving ratio, and the savings amount, with the independent variables discussed previously, so as to enhance an understanding of British households' saving behaviour.

CHAPTER 4 : ECONOMETRIC METHODOLOGY

4.1 INTRODUCTION

This chapter addresses the econometric estimation methods that are used in the empirical analyses for the three stages of empirical investigation.

A single econometric function with saving motives as the dependent variable is used to estimate the first stage. Owing to the qualitative characteristic of the dependent variable, a random-effect ordered Probit regression model is applied on unbalanced panel data from the year 2000 to 2004 (wave 10 to wave 13) of the British Household Panel Survey (BHPS). Whilst individual-invariant time effects – through time dummies - and unobserved individual heterogeneity – though fixed-effect or random-effect parameters - can be explicitly measured in the panel data analysis, it is assumed that the estimated coefficient of a given control variable is consistent over time. To follow up, a seemingly unrelated regression (SUR) model is employed. A SUR model allows for multiple equations in the same framework (system) by assuming that these equations are correlated; in this study, the SUR model applied comprised of four equations, representing individual cross-sectional ordered Probit specification for the four waves. Hypothesis tests for the equality of the coefficients of the given independent variables over the four waves are applied.

The second stage empirical work aims to examine the extent to which households' long-term and short-term saving ratios change, with respect to the specified control variables. The measured long-term savings-to-permanent income ratio and the imputed short-term savings-to-permanent income ratio are the dependent variables respectively. As explained in chapter three, household's long-term savings and short-term savings are measured according to a weighting standard: total savings amount of every individual member of a given household is collected and separated, according to his/her saving motive, into savings for the long term and saving for the short term. Household's long-term savings and short-term savings are obtained by summing up each member's long-term and short-term savings. A very common problem in microeconomic data is the censoring of a dependent variable. When the dependent variable is censored, values in a

certain range are all transformed to a single value (Greene, 2003). The censoring point can be at an upper limit, at a lower limit, or both. The distributions of two types of imputed household saving ratio have the censoring point at value '0'. In pursuing the panel data estimation, a random-effect Tobit regression model was applied to two single equations, one with the long-term saving ratio as the dependent variable and the other with the short-term saving ratio as the dependent variable in this role. The estimated coefficients from the Tobit model contain two types of effect: one is on the change in the possibility of the observations that are censored and the other is on the change in the level of the observations that are not censored. Marginal effect estimation was also applied to break down the two aforementioned types of effect.

In the third stage, the research explores the long-term savings-age profile and the short-term savings-age profile at the household level. A nonparametric kernel-smoothed conditional quantile regression model was adopted to investigate the relationship between the savings amount and age for each cross-sectional wave sample.

The main body of this chapter is organised as follows. Section 4.2 addresses the estimation methods applied for the first stage empirical work. Section 4.3 explains the methodology of the second-stage empirical work. Section 4.4 goes through the third-stage estimation approach. Finally, this chapter is completed with a conclusion in section 4.5.

4.2 ANALYSIS OF SAVING MOTIVES

4.2.1 Random-effect ordered Probit model

The first empirical work of this research aims to examine simultaneously the change in likelihood that a household (represented by head of household) has mainly a short-term saving motive or mainly one for the long term. In chapter 3, it was stated that the households, namely, the heads of the households, were asked the main savings motives for their savings over the past 12 months. The savings motives were particularly specified as for the long-term motive, the short-term motive, or both long-term and short-term equally. The long-term motive observations are coded as '0', both long-term

and short-term motive as '1', and short-term motive as '2'. When playing the role of a dependent variable, the three saving motives are characterised as a rank of categories. An ordered Probit model is able to account for the ordinal nature of it (Zavonia and McElvey, 1975); a random-effect ordered Probit model is chosen as the econometric methodology, and this method is illustrated below.

The econometric equation is defined as,

$$SIT_{it}^{*} = \alpha \hat{Y}_{it}^{P} + \beta' IU_{it} + \gamma' IA_{it} + \varphi' X_{it} + \lambda time_{t} + v_{i} + \varepsilon_{it} ,$$

$$SIT_{it} = 0 \text{ if } SIT_{it}^{*} \leq 0 ,$$

$$= 1 \text{ if } 0 < SIT_{it}^{*} \leq m_{1} ,$$

$$= 2 \text{ if } m_{1} < SIT_{it}^{*} \leq m_{2} ,$$

where t denotes waves (10~13) and i denotes households. The m s are unknown parameters to be estimated with the coefficient parameters. In the model, the dependent variable, SIT_{it}^{*}, is a latent variable and is unobserved. What is observed is SIT_{it}, representing saving motives reported by household i at wave t. SIT_{it} denotes the three specified saving motives: $SIT_{it} = 0$ represents the motive of mainly for the long term, $SIT_{it} = 1$ represents the motive of for both equally, and $SIT_{it} = 2$ represents the motive of mainly for the short term. The dependent variable is categorised in an ordered form, indicating that the strength of the short-term saving motive increases as the code is close to two and, on the other hand, the long-term saving motive increases as the code is close to zero. Owing to being in a panel-data specification, the saving motive of a household (the head) can be changing temporally. $\hat{Y}^{P}$ denotes the estimated permanent income of each household, and the estimation method will be addressed in the following section. IU denotes a matrix of three variables, each of them including three dummy variables. These variables consist of each household's expectation of its uncertainty in the next 12 months, of its household's current financial situation, and of its financial situation in comparison to that of the previous year. IA denotes a matrix of two variables: one is the dummy indicator for homeownership and the other is the dummy indicator for private pension enrolment. X denotes a matrix of the socio-economic and demographic features of each head of household. Finally, *time* denotes a matrix of year (wave)

dummies. The details of these explanatory variables have been presented in chapter three. $\alpha, \beta, \gamma, \varphi, \lambda$ denote the coefficient parameters to be estimated.

The error term is made up of an unobservable household-specific time-invariant effect, denoted as v_i, which is assumed to be randomly distributed and captures the unobserved heterogeneity of the household, and of an idiosyncratic error term, denoted as ε_{it}, where $v_i \sim IID(0, \sigma_v^2)$, $\varepsilon_{it} \sim IID(0, \sigma_\varepsilon^2)$. There are two justifications to be made regarding the assumption of the error term: one is the assumption of the unobserved element of the household heterogeneity being a random effect as opposed to being a fixed effect, and the other is the specification of the one way error against the two way error component.

The justifications of choosing a random-effect model will be discussed below. In a fixed effect model, the unobserved individual/household effect, denoted as v_i, is assumed to be a fixed parameter to be estimated. A fixed effect model would be an appropriate specification if the research aimed to focus on a specific of N individuals or firms, but this would restrict the analysis to the behaviour of these sets of micro units. However, for large consumer panel where N is large, a fixed effect regression may not be feasible as one is including $N-1$ dummies in the regression and thus this suffers from a large loss of degrees of freedom. If a fixed effect model is employed on panel data, as $N \to \infty$, for a fixed time period (T), the number of parameters v_i increases with N, which means that v_i cannot be consistently estimated for a fixed T. This is known as the incidental parameters problem. In addition, a fixed effect model cannot estimate the effect of any time-invariant variables, such as sex and highest educational attainment level. It would seriously weaken the empirical specification in this research to drop such factors as sex, because it is evident that the difference in gender makes a significant contribution in explaining the households' saving behaviour. A random effect model appears to be an appropriate specification, if the N individuals are drawn randomly from a large population, which is the case for the British Household Panel Survey. Hence, in a random effect model, the unobserved effect (v_i) is assumed to be random and independent from the explanatory variables and the rest of the error term.

Most of the panel data analyses utilize a one-way error component model for the disturbances, with $\mu_{it} = v_i + \varepsilon_{it}$, where v_i denotes the unobservable time-invariant individual specific effect and ε_{it} denotes the remainder disturbance. By comparison, a two-way error component disturbance is exhibited as $\mu_{it} = v_i + \lambda_t + \varepsilon_{it}$, where v_i denotes the unobservable time-invariant individual specific effect, λ_t denotes the unobservable individual-invariant time effect, and ε_{it} denotes the remainder disturbance. In this research, the framework employs a one-way error component regression model, as the time dummies are specified explicitly in order to capture unobserved macroeconomic effect, and hence, the one-way error component refers only to the time-invariant individual effect.

The estimation is carried out using a maximum likelihood estimator. The estimated coefficients are to be interpreted as the direction and scale of the effect that the explanatory variables have on the *change of the likelihood* of the saving motives. A positive sign on an explanatory variable's coefficient indicates the tendency towards saving for the short term and the absolute value of the coefficient shows the change in likelihood of such saving. A negative sign shows the opposite effect, i.e. a household saves mainly for the long term.

4.2.2 Estimation method of permanent income

The concept of *permanent income* comes from the Milton Friedman's *permanent income hypothesis*. Permanent income is determined by a consumer's assets: physical assets (shares, bonds, property) and human assets (education and experience). These influence the consumer's ability to earn income. The measured income contains a permanent (anticipated and planned) element and a transitory (windfall gain/unexpected) element.

In Kazarosian (1997), to distinguish permanent income from current measured income, a random effect general least square (linear) model was employed on panel data, $Y_i^P = Z_i\beta + \delta_i$, where Z_i is a vector of households' observable characteristics, with the parameter vector β. δ_i is the time consistent household-specific error, $\delta_i \sim N(0, \sigma_\delta^2)$.

Permanent income Y_i^P is the annual income with no transitory component, evaluated at the same age for everyone. The current income is,

$E_{it} = Z_{it}\beta + g(A_{it}) + \delta_i + \mu_{it}$, where E_{it} is the household annual income in year t for household i, $g(A_{it})$ is the age-income profile, and μ_{it} is the observation-specific error. The estimated permanent income is obtained from the *fitted value* of a random-effect general least square model, in which the log of the household's observed total annual income is regressed on observable characteristics of the heads of household.

In this study, the observed characteristics include: gender, age, age^2, education dummies, occupation dummies, interaction of age and age^2 with the education dummies and the occupation dummies - age × education dummies, age × occupation dummies, age^2 × education dummies, and age^2 × occupation dummies -, residential area dummies, marital status, number of children in the household, whether individuals have spouse/partner in employment, and homeownership dummy (Kazarosian, 1997; Guariglia, 2001; Carroll, Dynan, and Krane 2003; Benito, 2004). Hence, the estimating equation is,

$$\ln E_{it} = a_0 + b_1 age_{it} + b_2 age_{it}^2 + b_3 gender_{it} + b_4 DUM(education) + b_5 DUM(occupation)$$
$$+ b_6 age \times DUM(education) + b_7 age \times DUM(occupation) + b_8 age^2 \times DUM(education)$$
$$+ b_9 age^2 \times DUM(occupation) + b_{10} DUM(residence) + b_{11} DUM(maritalstatus)$$
$$+ b_{12} DUM(children) + b_{13} DUM(spouseemployment) + b_{14} DUM(\text{hom}eownership) + \delta_i + \mu_{it}$$

where i denotes household, t denotes waves 10~13, δ_i denotes the time-invariant unobserved household characteristic which is assumed to be randomly distributed, and μ_{it} is the idiosyncratic error term. The estimated value of the log permanent income is the sum of the predicted value and the estimated time-invariant household effect, denoted as $(\ln \hat{E}_{it} + \delta_i)$. The estimated permanent income level is calculated by taking the function below,

$\hat{Y}_{it}^{\,P} = \left(\ln \hat{E}_{it} + \delta_i\right)^e$. The estimated coefficients are reported in Table 4.1.

Table 4.1: Random effect general least square model on log of household income

Independent variables	*Coefficient*	*Stand Deviation*
Female	-0.06***	0.022
Age	0.135***	0.044
Age squared	-0.002***	0.000
Education		
Higher than first degree	0.770	0.607
First degree	0.443	0.408
Some college	0.273	0.318
A Level	0.901**	0.419
Occupation		
Managers & Administrators	1.912**	0.945
Professional	2.524**	0.990
Associate professional & Technical	1.742*	0.962
Clerical & Secretarial	1.763*	0.958
Craft related	1.950**	0.949
Personal & Protective service	2.268**	1.111
Sales	0.726	1.035
Age*Education		
Higher than first degree	-0.019	0.030
First degree	-0.004	0.020
Some college	-0.006	0.015
A Level	-0.036*	0.020
Age squared*Education		
Higher than first degree	0.0003	0.0004
First degree	0.000	0.0002
Some college	0.0001	0.0002
A Level	0.0004*	0.0002
Age*Occupation		
Managers & Administrators	-0.084*	0.044
Professional	-0.111**	0.046
Associate professional & Technical	-0.078*	0.045
Clerical & Secretarial	-0.077*	0.045
Craft related	-0.088**	0.044
Personal & Protective service	-0.106**	0.053
Sales	-0.051	0.048
Age square*Occupation		
Managers & Administrators	0.001**	0.0005
Professional	0.001**	0.001
Associate professional & Technical	0.001*	0.0005
Clerical & Secretarial	0.001*	0.0005
Craft related	0.001**	0.0005
Personal & Protective service	0.001**	0.001
Sales	0.001	0.001
Region		
Greater London	0.044	0.041
South West	-0.159***	0.042
East	-0.143***	0.037
West Midlands	-0.174***	0.043
Greater Manchester	-0.116**	0.057
North West	-0.124***	0.046
Yorkshire & Humberside	-0.166***	0.041
Tyne & Wear	-0.162***	0.046
Wales	-0.246***	0.031
Scotland	-0.191***	0.029
Northern Ireland	-0.210***	0.031

Married/Cohabiting	0.315***	0.025
With children	-0.001	0.016
Spouse/partner employed	0.210***	0.020
Pension enrolment	-0.008	0.014
Homeownership	0.235***	0.021
Year dummy		
2000-2001	-0.054***	0.012
2001-2002	-0.043***	0.012
2002-2003	-0.015	0.011
Constant	6.782***	0.942

Number of observations	7763
Log likelihood	-4894.445
LR Chi square	1782.84
P-value	0.000
ρ (rho)	0.658

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

4.2.3 The Seemingly Unrelated Regression (SUR) model

In this section, the aim is to investigate both the influence and stability, over time, of the explanatory parameters. A seemingly unrelated regression, known as a SUR model, is applied to accommodate multi-equations in a single model. In this model, the time-consistency of the effects of a given independent variable over time can be tested.

Panel data estimation is an example of systems of equations, as all explanatory variables are dated contemporaneously; estimated correlations reported by a panel data estimation method are assumed to be long-term relationships. For instance, previously in the random-effect ordered Probit model, the estimated coefficients of the independent variables were assumed to be consistent over time. The error component in such a model took into account of the time-invariant unobserved heterogeneity of households and time effects. A SUR model is another example of systems of equations (Zellner, 1962) and is considered an alternative estimation approach to be used on cross-sections with time-series data. A SUR estimation technique is employed in this study mainly to test whether or not the coefficients would be statistically significantly time-invariant, that is, to test the stability of the estimated coefficients of each set of cross-section data over time. The hypotheses will not be rejected in the case of stability.

The SUR model, in this case, specifies the t th of the T equations, where T denotes the waves 10~13 for the i th of N households to be given by:

$$SIT^{*}_{i10} = \alpha_{10}\hat{Y}^{p}_{i10} + \beta'_{i10}IU_{i10} + \gamma'_{10}IA_{i10} + \varphi'_{10}X_{i10} + \varepsilon_{i10},$$

$$SIT^{*}_{i11} = \alpha_{11}\hat{Y}^{p}_{i11} + \beta'_{i11}IU_{i11} + \gamma'_{11}IA_{i11} + \varphi'_{11}X_{i11} + \varepsilon_{i11},$$

$$SIT^{*}_{i12} = \alpha_{12}\hat{Y}^{p}_{i12} + \beta'_{i12}IU_{i12} + \gamma'_{12}IA_{i12} + \varphi'_{12}X_{i12} + \varepsilon_{i12},$$

$$SIT^{*}_{i13} = \alpha_{13}\hat{Y}^{p}_{i13} + \beta'_{i13}IU_{i13} + \gamma'_{13}IA_{i13} + \varphi'_{13}X_{i13} + \varepsilon_{i13},$$

Where disturbance is independent of any control variables, and disturbances are uncorrelated across observations. The definitions of the variables are identical to those in the previous section. The four equations above have identical explanatory variables, and are linked by their disturbances. The SUR model is based on an assumption that there are correlations amongst disturbances of equations, that is, the equations are related if the errors ε in different equations are correlated[84]. For example in this study, the relationship between, say SIT^{*}_{i10} and SIT^{*}_{i11} , is indirect, as it comes through correlation in the errors across different equations.

Accounting for these correlations amongst the errors aims to increase the asymptotic efficiency of the estimates of the causal parameters. One may assume some pattern regarding the correlations of the errors, such as a first order autoregressive scheme in the time direction, in order to reduce the number of unknown parameters to manageable proportions (Wallace and Hussain, 1969). For instance, applying this method to estimate the determinants of the percent of each state's population receiving general assistant payment by using cross-sections with time-series data in the United States, Brehm and Saving (1964) assumed that the correlations were bothersome only in one direction, i.e. time.

Compared with that of a cross-sectional estimation model, the efficiency gain of a SUR model is affected by the correlation between disturbances of equations: the greater the correlation the greater the difference between the SUR variance and the ordered Probit variance, in the case of this study. Moreover, Binkley and Nelson (1988) proposed that the multicollinearity of variables influenced the gain in efficiency, in a SUR model. Such multicollinearity operates in two distinct ways: the first involves correlation amongst variables in one equation and those in the other. The second involves not only

[84] If the assumption does not hold, the SUR system would collapse to single equation estimation.

the correlation amongst the variables across the equations but also that within them[85]. It thus was posited that the gain in efficiency could be large, even if correlation between variables within the equation and between the equations existed.

Concerning this study, the estimation thus combines observations over both equations (waves) and households, and the estimates obtained exhibit identical coefficients with those obtained in the cross-sectional ordered Probit model, yet, there are difference in the standard deviations. This is because such a joint estimation is the gain in efficiency that results from incorporating correlation in unobservable factors across equations for a given individual. Thus, it does not impose a distribution on those unobservable effects, in contrast to the random-effect panel data estimation. The assumption of the correlations across equations can allow for unobserved effects for a given household. For instance, a household had a major consumption of durable goods in a specific wave, and there is reason to believe that such an effect also exists in the preceding or succeeding waves. Moreover, a macroeconomic shock, such as a change in policy, is likely to last over time.

After the estimated coefficients are estimated in a SUR model, it is possible to test the coefficients across the equations. Zellner (1962) developed a technique to test the *aggregation bias*: this is in the case that the control variables matrices of each equation are all of the same size and represent matrices of observations on particular variables relating to different micro-units. The testable hypothesis is $H_0 : \beta_1 = \beta_2 = ... = \beta_M$, where each β denotes the coefficient parameter of each equation, and M counts as the number of equations in the regression model. The hypothesis mentioned above states that micro-units, i.e. households in this study, are *homogeneous* insofar as their regression coefficient vectors are concerned. The adapted regression model in this study contains four equations and each of them represents the estimates for a given wave. Accordingly, the test is eligible for determining whether the coefficient vectors are time-consistent across the four waves. For example, when the coefficient vector of a given control variable, say permanent income, is to be tested, the null hypothesis is proposed as:

[85] See Binkley and Nelson (1988) for technical illustrations.

$\alpha_{10} = \alpha_{11} = \alpha_{12} = \alpha_{13}$, for which chi-squared statistics are applied. Given the hypothesis of aggregation bias is not rejected, the estimated coefficients of the SUR model exhibit the fluctuations of coefficients of a given independent variable. Moreover, the SUR model cannot measure the unobservable household effect, which, by contrast, can be done in panel-data analysis.

The SUR model has become a popular tool in investigating financial market behaviour, for instance, the determinants of the expected return of five different financial commodities can be modelled in a SUR model with five equations, allowing for the correlation among the return rates of those commodities. Also, it is also widely used in other fields, such as environmental studies, Biology, etc. (Næsset, Bollandsås, and Gobakken, 2005; Carroll, Midthune, Freedman, and Kipnis, 2006)

4.3 ANALYSIS OF SAVING RATIOS

4.3.1 Random-effect Tobit model

A very common problem in microeconomic data is the censoring of the dependent variable. When the dependent variable is censored, values in a certain range are all transformed to a single value (Greene, 2003). In this study, the short-term saving ratio and the long-term saving ratio will be examined separately with respect to the explanatory variables. It is observed that many households have a zero (measured) short-term saving ratio or a zero (measured) long-term saving ratio. Figure 4-1 and Figure 4-2 below demonstrate the distribution of the two dependent variables; as can be seen, the dataset contains censored observations at value'0'. The distribution theory for a censored variable is similar to that for a truncated one. In a truncated distribution, only the part of the distribution above the censoring point, say zero, is relevant to the computation; when the data is censored, the distribution is a mixture of both discrete and continuous[86].

[86] To analyse this distribution, a newly-defined random variable y is transformed from the original one, y^*, by $y = 0$ if $y^* \leq 0$, $y = y^*$ if $y^* > 0$. The distribution that applies if $y^* \sim [\mu, \sigma^2]$ is Prob($y = 0$) = Prob($y^* \leq 0$) = $\Phi(-\mu/\sigma) = 1 - \Phi(\mu/\sigma)$, and if $y^* > 0$, then y has the density of y^*.

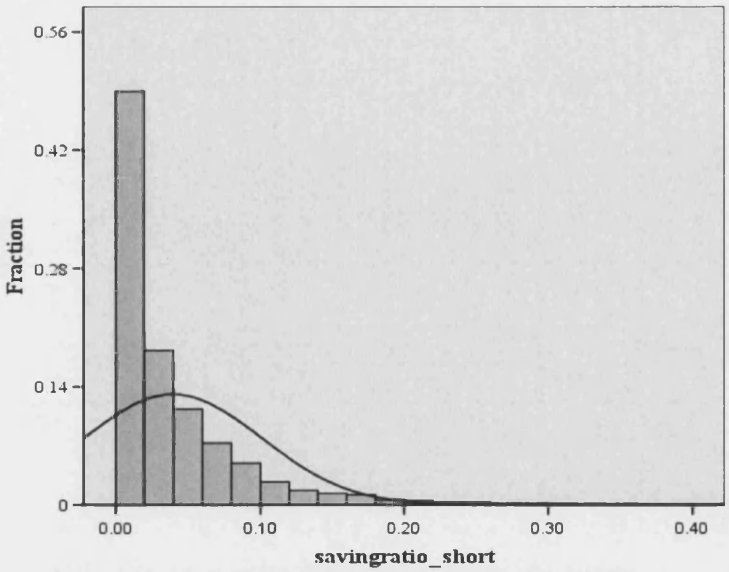

Figure 4-1: Distribution of the short-term saving ratio

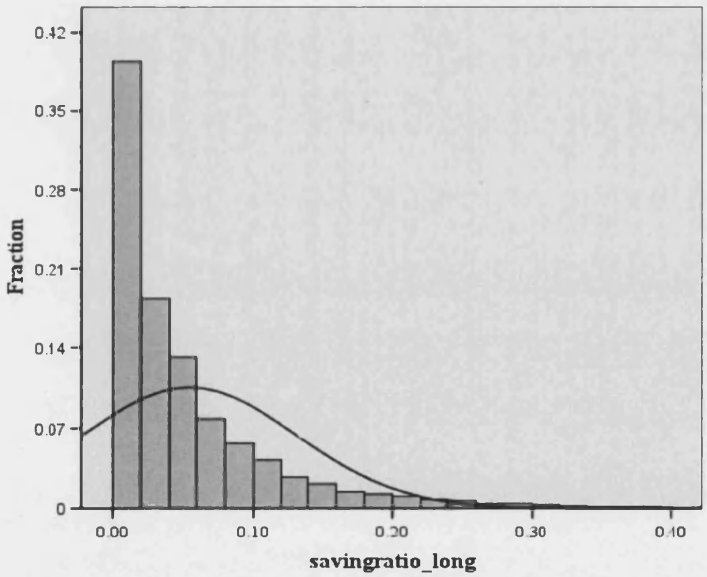

Figure 4-2: Distribution of the long-term saving ratio

A censored regression model or the Tobit model (Tobin, 1958) assumes that the dependent variable has a number of its values clustered at a limiting value, usually zero. It can be employed to meet the characteristic of the censored dependent variable at no cost of invalidating some observations because the Tobit technique uses all observations, both those censoring and above the limit, to estimate a regression line.

In this study, a random-effect Tobit model is applied for estimation. The estimation equation is given in terms of an index function,

$$\frac{S_{it}}{Y_{it}^{P}}^{*} = \alpha_0 + \alpha_1 Y_{it}^{P} + \alpha_2 F_{it}^{e} + X_{it}'\beta + \varsigma_t'\gamma + v_i + e_{it},\ e_{it} \sim IID(0,\sigma_e^2)\ \ v_i \sim IID(0,\sigma_v^2)$$

where i denotes each household, and t denotes the waves 10~13.

$\frac{S_{it}}{Y_{it}^{P}}^{*}$ is a latent variable and denotes either the observed short-term saving ratio or the observed long-term saving ratio of each household at a given wave.

$$\frac{S_{it}}{Y_{it}^{P}} = 0 \quad \text{if } \frac{S_{it}}{Y_{it}^{P}}^{*} \le 0$$

$$\frac{S_{it}}{Y_{it}^{P}} = \frac{S_{it}}{Y_{it}^{P}}^{*} \quad \text{if } \frac{S_{it}}{Y_{it}^{P}}^{*} > 0$$

Y_{it}^{P} represents the estimated permanent income of each household at a given time, and serves as a proxy for the household wealth level. F_{it}^{e} denotes each household's subjective evaluation of its financial situation in the next 12 months, reflecting expectation regarding the general economic situation, including inflation and unemployment, as well as the expectation of their financial status. X_{it} denotes a vector of control variables, such as the household's current financial situation, financial realisation compared to one year ago, age, age squared, education dummies, region dummies, the household size, with/without children, marital status, self-employed/employee, owning housing wealth, paying into a private pension, saving for any specific reason or not, and fulltime/part-time employment. ς_t denotes the year dummies. v_i denotes unobserved household effect and is assumed to be randomly distributed and independent of the independent variables and the rest of the error term. e_{it} is the idiosyncratic error term. The estimated coefficients are taken as the value of the maximum of a log-likelihood function.

The estimation formula of the random effect Tobit model is simplified as $y_{it}^{*} = x_{it}'\beta + v_i + e_{it}$, where y^{*} is the index variable, or latent variable, and x is a

vector of control variables, v_i denotes the household-specific characteristics, and e_{it} is the error term. The marginal effect for the index variable is calculated as

$$\frac{\partial E(y_{it}^{*} \mid x_{it})}{\partial x_{it}} = \beta .$$

However this does not reveal to what extent the change of a given explanatory variable affect the dependent variable because y^{*} is only an index variable and unobserved. For the observed data, y_i, in the case with censoring at zero and normally distributed disturbances, the result specialises to

$\frac{\partial E(y_{it} \mid x_{it}, v = 0)}{\partial x_{it}} = \beta_{it} \Phi\left(\frac{\hat{\beta}\bar{x}_{it}}{\sigma_e}\right)$, where Φ denotes the standard normal cumulative distribution function, $\bar{x}_{it}$ denotes the sample mean, and σ_e denotes the standard deviation of the error term. The estimation in a random effect model involves unobserved household effect, thus, in practice, the marginal effects are estimated by making normalization of the household effects such as $E(v) = 0$.

McDonald and Moffitt (1980) have suggested a useful decomposition of $\frac{\partial E(y_{it} \mid x_{it})}{\partial x_{it}}$,

$$\frac{\partial E(y_{it} \mid x_{it})}{\partial x_{it}} = \Pr ob[y_{it} > 0] \frac{\partial E[y_{it} \mid x_{it}, y_{it} > 0]}{\partial x_{it}} + E[y_{it} \mid x_{it}, y_{it} > 0] \frac{\partial \Pr ob[y_{it} > 0]}{\partial x_{it}}$$ [87]

The equation above indicates that the change of a given explanatory variable on the short-term/long-term saving ratio is composed of two elements: the effect from the increased short-term/long-term saving ratio of the households who did already save for a short-run/long-run purpose, and the effect due to those households who did not have short-term/long-term savings before and start to save for the short term/ long term as a consequence. The proportion of the former effect can be expressed in the formula,

$A = 1 - \frac{zf(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}$, where $f(z)$ represents the unit normal density, and $F(z)$ represents the cumulative normal density function. In this work, the two types of

[87] This equation confirms that a change in x_i has two effects: it affects the conditional mean of y_i^{*} in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. The relative magnitudes of these two quantities are an important indicator with economic implication. (McDonald and Moffitt, 1980)

estimated marginal effect will be reported simultaneously, and the relative magnitudes of the two effects on a given control variable measured and compared.

There has been much fruitful literature on the application of the random effect Tobit model as the estimation approach, and a few of these works are outlined here. Guariglia (2001) employed a random effect Tobit model to investigate British household's saving behaviour, by looking at how the change in income uncertainty affects the changes in savings. Coxhead and Demeke (2004) employed a random effect Tobit model to quantify the land-use responses to economic signals, especially agricultural prices. Jaegar, Bonin, Dohmen, Falk, Huffman, and Sunde (2007) employed a random effect Tobit model on a recent dataset of the German Socioeconomic Panel (GSOEP), to estimate the relationship between an individual's attitude toward risk and his/her migration propensities. Considering the technique suggested in McDonald and Moffitt (1980), the results seemed to show that the risk attitudes play a much larger role in determining whether or not people migrate than in determining how far they migrate. This underlines the effectiveness of using the technique developed by McDonald and Moffitt (1980), after estimation of the random-effect Tobit regression, to distinguish the two effects, as is one of the key aims of this study.

4.4 ANALYSIS OF SAVINGS-AGE PROFILE

In the previous stages, the parametric analysis has included an investigation of the effects that age or any other characteristic factors have on households' saving behaviour. However, the overall savings-age profile over the working life cycle is still unknown by this method. In this stage, the research question lies in the distribution of savings – long-term savings and short-term savings – throughout the working life cycle, which is specified as between age 25 and age 65 in this work.
Correspondingly, the empirical framework simplifies into a univariate function,
$Savings = f(age)$.

Life-cycle consumption/saving decisions have been addressed at the household level in the conventional life-cycle hypothesis. The information about consumption/savings is

generally collected at the household level; accordingly in the empirical literature the heads of the households are assumed to represent the household units. Yet, there is no reason to believe that the head of household's saving behaviour is consistent with other members in the household. Deaton and Paxson (2000) developed a life-cycle model at the individual level, to address the possible bias problem with estimating savings-age profile at the household level. Such a concern arises, in that the members who live in the same household are at different age phases of the life cycle, for example, a 50-year-old head of household living with a 22-year-old son and a 75-year-old parent. Demery and Duck (2006) also examined this issue and found that the estimation at the household level exaggerates the savings rate of young adults and the elderly, whilst underestimating the savings rate of the 45 to 60-year-olds.

Nevertheless, this work remains focused at the household level with two justifications. Firstly, the research question of this study is derived from the life-cycle theories in which arguments are addressed at the household level. Secondly, the observed savings of each household unit is obtained by aggregating individual savings for every adult member interviewed within the household; this not only reflects individual saving decision-making of each member within the same household but also allows for interactive influence amongst family members. For instance, whilst the main earners may mainly take charge of savings for the long term, the spouses put their emphasis on saving mainly for the short term.

4.4.1 Nonparametric kernel-smooth conditional quantile model

The non-parametric kernel-smoothed conditional quantile estimation method, developed by Magee, Burbidge, and Robb (1991), is employed to accomplish the estimations for savings-age profiles. This method was originally developed to estimate the savings-age profile at the first, second, and the third quartiles. In this work, only the estimated median savings-age distribution is reported. A non-parametric estimation method plays a role in descriptively showing the relationship between the variables, with no need for any specific assumption about the distribution of the error term. The quantile analysis method allows one to look at not only the sample in the middle of the distribution, but also at that in the upper and lower bands. In addition, the median estimates are less vulnerable to distortion due to extreme observations, whereas the

mean estimates would easily encounter such a problem in a skewed dataset, which is the case in the dataset of this work.

A kernel is a weighting function used in non-parametric estimation techniques. Kernels are used in kernel density estimation to estimate random variables' density functions, or in kernel regression to estimate the conditional expectation of a random variable. Several types of kernel functions are commonly used: uniform, triangle, epanechnikov, quartic(biweight), tricube (triweight), gaussian, and cosinus.

Accordingly, a non-parametrically quantile estimation conditioned on ages, seems to be a favourable approach to look into households' saving/consumption behaviour over the working life-cycle. Magee, Burbidge, and Robb (1991) firstly applied this method to examine the wealth holdings-age profile of Canadian households. The data they used was a survey conducted by Statistics Canada in 1977. Robb, Magee and Burbidge (1992) investigated the consumption-age profile of Canadian households by using a kernel-smoothed conditional quantile estimator on four cross-sectional datasets from 1978, 1982, 1984, and 1986 of the Canadian Consumer Expenditure Survey. Alessie, Lusardi, and Aldershof (1997) used the kernel-smoothed conditional quantile estimator to study the net worth-age and savings-age profile on the 1987 Dutch dataset, Socio-Economic Panel (SEP).

The basic algorithm is presented below. In the following, α represents the quantile of the distribution of Y given $X = x$ as $q_\alpha(x)$, which solves

$$F(q_\alpha(x)|x) = \alpha, \qquad (1)$$

Where $F(y|x)$ is the conditional cumulative distribution function (cdf) of Y given x evaluated at $Y = y$. An estimate $\hat{q}_\alpha(x)$ can be obtained from the observed pairs (X_i, Y_i) $(i = 1,...,n)$ by solving (1) after replacing F with some estimate $\hat{F}$. One choice of $\hat{F}$, which smoothes over X, is

$$\hat{F}(y|x) = \sum_i K\{(X_i - x)/h\} I[Y_i \le y] \Big/ \sum_i K\{(X_i - x)/h\},$$

Where K is a kernel function and I is the indicator function: $I[A] = 1$ if A is true, $I[A] = 0$ otherwise. In order to choose the bandwidth parameter h, a leave-one-out

cross-validation (CV) approach is used in which h is chosen to *minimise the loss function*

$$L(h) = \sum_i r_\alpha (Y_i - \hat{q}_\alpha^{(i)}(X_i)),$$

Where $r_\alpha(z) = |\alpha - I[z < 0]|$. $|z|$ is the leave-one-out loss function employed and $\hat{q}_\alpha^{(i)}$ denotes the estimate of $q_\alpha(X_i)$ using bandwidth h, where observation i has been dropped from the sample.

The cross-validation approach is a non-parametric estimation of statistical error, mainly the bias and standard error of an estimator. It is a way of obtaining nearly unbiased estimators of prediction error. The method deletes the observations X_i from the data set *one at a time*, and recalculates the prediction rule on the basis of the leave-one-out sample. It shows how well the recalculated rule predicts the deleted observation, and takes the averages of these predictions calculated by deleting one observation at a time. (Efron and Gong, 1983)

Under the empirical framework of this study, Y_i denotes either the imputed short-term savings or the imputed long-term savings of each household, and X_i denotes the age of the head of each household. $\alpha = 0.25, 0.5, 0.75$. Kernel smoothing involves a kernel function, $f(x-a)$, which gives the weight to be attached to observations at age x in the estimation of age a.

Two aspects of the kernel should be chosen by investigators: the bandwidth and the shape. The h parameter is the bandwidth, or range, of the kernel, over which the function is non-zero; the shape of the kernel is usually chosen to be symmetric about zero. A triangular kernel is subjectively chosen for this study, as different types of kernel function seem not to matter a great deal (Robb, Magee, and Burbidge, 1992). As previously mentioned, the selection of bandwidth h is a crucial parameter for the estimation, and as a consequence a great deal of repetition is involved in the estimation process. The initial bandwidth is chosen by the experience rule in the literature; accordingly, a first guess starts from '10' for the estimation of each sample. The savings-age profile estimation is employed for the whole sample and in the five sub-

samples – males, females, homeowners, private pension participants, and employees. Correspondingly, an individual bandwidth is chosen for each sample in the estimation process. See Table 4.2 and Table 4.3 below for choices of bandwidth. It is the case that the estimated profiles of some the sub-groups appear to be too fluctuating, and as a result of that the small sample sizes carry a lot of noise (Robb, Magee, and Burbidge, 1992). In an attempt to smooth out the curve, a larger bandwidth is chosen, taking care that the new bandwidth will not distort the trend throughout the age ranges.

Table 4.2: Bandwidth chose for whole sample

	Wave10	*Wave 11*	*Wave 12*	*Wave 13*
Total savings	10.4	16	16.4	13.6
- Long-Term savings	12	10	14	24
- Short-Term savings	14.6	18	8.8	12.2

Table 4.3: Bandwidth of sub-samples

		Wave 10	*Wave 11*	*Wave 12*	*Wave 13*
Males	- *Total savings*	12	16.6	23	21
	- Short-term savings	17.7	16	15.2	12
	- Long-term savings	12.2	16	11.8	14.3
Females	- *Total savings*	17.8	15.4	14.9	20
	- Short-term savings	20	22	25	27.2
	- Long-term savings	21	26	20.6	19.6
Employees	- *Total savings*	10.8	20	18	10.4
	- Short-term savings	28	22	9	9.6
	- Long-term savings	9.6	9.9	10.3	24
Homeowners	- *Total savings*	10.2	16	18	10
	- Short-term savings	21.8	17.5	9.9	9.8
	- Long-term savings	10.2	21.6	12	12
Pension-participants	- *Total savings*	10.4	10	12.8	16
	- Short-term savings	13	22	10	20
	- Long-term savings	9.3	10	15.1	12.2

One shortcoming of cross-sectional analysis is that it is not able to track changes in the savings-age profile of the same individuals over time. A repeated cross-sectional data is an alternative under the condition of a lack of genuine panel data. In the dataset obtained for this study, some household observations only appear once among the four

cross sections, a sample of the same age cohort is observed in the four waves. Accordingly, it is to track the savings distribution not of the same observations, but of a representative sample of households of the same age cohort.

Treatments for distinguishing the age effect from the cohort (year of birth) effect and time effect have been abundantly applied in a number of empirical works that adopt parametric estimation methods, which will be discussed below. In practice, it is not possible to disentangle the three types of effect. As a complex mechanism among these three types of effects evolves, making some assumption is a common procedure. For instance, the time effect, which captures the business cycle effect, is often assumed to average to zero and is orthogonal to the linear trends (See Attanasio, 1998; Demery and Duck, 2006). A long panel data or a long quasi-panel is required to make age and cohort effects analysis feasible: Attanasio (1998) aimed to discriminate between the two effects when looking at the savings-age profile of US households by using a long panel taken from the Consumer Expenditure Survey (CEX), for the year 1980 to 1991; Jappelli and Modigliani (2003) investigated the cohort effect and age effect by taking a repeated cross-section dataset over 11 years; Demery and Duck (2006) investigated savings-age profile of UK households with a long panel dataset, using the British Family Expenditure Survey (FES), for the period 1969 to 1998.

By contrast, the dataset for this study only covers a short time period, i.e. four years. This makes it implausible for this study to disentangle cohort effects from age effects. Furthermore, such a limitation is attributed to the estimation method applied for this study as this method was originally designed for cross-sectional dataset. Notwithstanding this, by applying cross-comparing estimates for each wave, it is still possible to detect other effects, other than the age effects, if a common trend in the four profiles representing the four waves can be observed. In addition, to control for the influence of the households' other characteristics, five sub-samples are selected out of each cross-sectional dataset, covering: gender, homeownership, pension-enrolment, and employment status (employees/self-employed). Comparisons of the savings-age profiles for different groups can be made, to discover whether the subgroups behave differently.

4.5 CONCLUSION

Three estimation methods chosen to carry out the empirical analyses of the three stages have been presented and related issues have also been discussed in this chapter[88]. In the first stage, a random-effect ordered Probit model was employed on a unbalanced panel data, consisting of four cross-sectional waves, in order to investigate the shift in likelihood of heads of households' saving motives, with respect to short-term uncertainty, wealth possession, and socioeconomic and demographic characteristics. In an attempt to test the time-consistency of coefficients over the four waves, a seemingly unrelated regression (SUR) model was subsequently carried out, which represented a single regression framework consisting of equations by waves.

In the second stage, a random-effect Tobit model was adopted to examine separately the changes in household's short-term saving ratio and long-term saving ratio, with respect to short-term uncertainty, wealth possession, and socioeconomic and demographic variables. Two types of marginal effects were estimated: one was the effect on changes of saving ratio of households who were already saving, and the other was the effect on changes in likelihood of households' making savings when they were not already doing so.

In the third stage, a non-parametric kernel quantile model was applied on each wave, to predict the median savings-age profile over the working life cycle. Households' short-term savings, long-term savings, and total savings – sum of the two types of savings – were consecutively estimated against age. Disentangling age effects, cohort (year of birth) effect, and life-cycle effects has been an important issue needing to be dealt with in previous empirical literature on savings-age profile. In this work, the time effect can be inspected by comparing the profiles of the four waves, however, the treatment for distinguishing cohort effect from age effect would require a long panel data, whereas the panel data used only covered four years, which was too short to allow for this treatment.

[88] This work used STATA version 8.0 to obtain estimation results for the first and second empirical studies, and GAUSS version 8.0 for the third empirical study. The programming code for the third empirical study is presented in section B of appendices.

CHAPTER 5 : SAVING MOTIVES, RISK, AND SELF-CONTROL PROBLEMS

5.1 INTRODUCTION

Since the 1990s, economists have paid much attention to the importance of the precautionary saving motive of households and individuals, and much of the related empirical literature has been accomplished by examining the change in savings/wealth in response to risk. Income uncertainty or risk is the most frequently employed risk indicator, which is specified as the small year-to-year fluctuations in wages and occasional large falls due to unemployment. This is used because unemployment risk has the biggest impact on people's income and consumption decisions. (Guariglia, 2001; Carroll, Dynan, and Krane, 2003; Benito, 2004) However, in addition to unemployment risk, other types of risks, such as health risk, are also reckoned to be important sources of uncertainty/risk over the life cycle, for instance, elderly households may perceive there to be a health risk rather than young households.

One aim of this study is to re-examine households' precautionary saving behaviour through the relationship between short-term saving motive and short-term aggregate risk. In comparison with the previous literature, this study has two advantages. One is that it looks directly at households' saving motives, and this, to some extent, solves the problem of heterogeneity of saving motives. This problem arises in that total saving amounts usually reflect a variety of saving motives, e.g. precautionary saving of a short-term time horizon and saving for retirement in the long term. In this work, a precautionary saving motive is clearly specified as the short-term motive of 'saving for unexpected events in the short term'. The other advantage is that this work uses subjectively perceived risk to capture a household's short-term aggregate risk over the next 12 months. This comes with two justifications: first, it is sensible to presume that households make decisions based largely on their subjective experiences and evaluations; second, financial expectation reflects not only whether the household will lose the income source, to wit, become unemployed, but also the shocks on financial

management, such as medical expenditure due to a health issue, and the volatility of income flow.

One contribution of this study is to take into account the concept that people possess inconsistent time preference (hyperbolic discount function) – a higher discount rate for the short term and a lower discount rate for the long term, and these two time preferences are dynamically changing. A saving motive for the long term shows households' preference for an intertemporal choice – giving up consumption now for consumption in the long-term future. Moreover, a saving motive for the short term is about giving up consumption now for a near-term purpose. As discussed previously, saving for the short term is posited to be unfavoured by a consumer with inconsistent time preferences and saving for the long term is more preferable.

The primary hypothetical correlation to support the buffer-stock model is that between financial expectations and saving motives. If subjective financial expectation plays a role in indicating the aggregate uncertainty or risk in the near future, presumed to be in the next 12 months, a precautionary saving motive hypothesis can be pinned down, by looking at the extent to which the households react to their perceived risk in the sense that their saving motive changes to being short-term oriented. To be specific, it is considered that, compared with those households with neutral financial expectation, households with a worse-off financial expectation are more likely to save mainly for the short term to buffer uncertainty in the near future.

The hypothetical correlation to support the quasi-hyperbolic consumption model is between holding of savings in illiquid forms and saving motives. Such a saving pattern ought to be observed amongst hyperbolic consumers: they prefer saving for the long term than saving for the short term, and tend to save in illiquid wealth or to join external saving schemes to commit themselves to savings. Thus, the hypothesis is that homeowners or private pension participants tend to save for the long term. Moreover, the precautionary saving effect may be missing amongst households whose time preferences are hyperbolic and thus inconsistent, and this is one anomaly between the buffer-stock and the quasi-hyperbolic consumption models. The intuition is that whilst consumers save more this period in response to higher risk in the next period,

households, if they have a hyperbolic time preference, would be too impatient to accumulate wealth for the next period.

In general, the purpose here is to examine the determinants of households' long-term and short-term saving motives. Precautionary saving behaviour, from a short-term perspective, is also investigated. Section 5.2 reviews the econometric models employed in this chapter. Section 5.3 discusses the results from the random-effect ordered Probit model for the whole sample and two subgroups – homeowners and private pension participants. Section 5.4 exhibits the estimation results from a Seeming Unrelated Regression (SUR) model. The fluctuations of effects for a given variable can be seen; moreover, the consistency over time of these effects can be investigated. Section 5.5 concludes this chapter.

5.2 REVIEW OF METHODOLOGY

5.2.1 Random-effect Ordered Probit model

In this model, the change in likelihood of discretionary saving motives - for short-term purposes or for long-term purposes, was investigated upon households' subjectively-perceived risk in the next year, ownership of housing wealth, private pension enrolment, and other socio-economic and demographic factors. The empirical model is as follows:

$$SIT_{it}^{*} = \alpha \hat{Y}_{it}^{P} + \beta' IU_{it} + \gamma' IA_{it} + \varphi' X_{it} + \lambda time_{t} + v_{i} + \varepsilon_{it} ,$$

$$SIT_{it} = 0 \quad \text{if} \quad SIT_{it}^{*} \le 0 ,$$

$$= 1 \quad \text{if} \quad 0 < SIT_{it}^{*} \le m_{1} ,$$

$$= 2 \quad \text{if} \quad m_{1} < SIT_{it}^{*} \le m_{2} ,$$

where t denotes waves (10~13) and i denotes households. The m s are unknown parameters to be estimated with the coefficient parameters.

In the model, the dependent variable, SIT_{it}^{*}, is a latent variable and is unobserved. What is observed is SIT_{it}, representing saving motives reported by household i at wave t. SIT_{it} denotes the three specified saving motives: $SIT_{it} = 0$ represents the motive of mainly for long term, $SIT_{it} = 1$ represents the motive of for both equally, and $SIT_{it} = 2$

represents the motive of mainly for short term. In this model, changes in the short-term saving perspective and long-term saving perspective of a household are observed over the four waves, and this allows for the change of saving preference of a given households, thus enabling the concept of dynamically inconsistent time preference to be explored.

Independent variables are in the right hand side of the equation. $\hat{Y}^P$ denotes the estimated permanent income of each household. IU denotes a matrix of three variables, each of them including three dummy variables. These variables consist of each household's expectation of its aggregate risk/uncertainty in the next 12 months, of its household's current financial situation, and of its recent financial experience compared with current status. IA denotes a matrix of two variables: one is the dummy indicator for homeownership and the other is the dummy indicator for private pension enrolment. X denotes a matrix of the socio-economic and demographic features of each head of household. Finally, *time* denotes a matrix of wave (year) dummies. The details of these explanatory variables have been presented in chapter three. $\alpha, \beta, \gamma, \varphi, \lambda$ denote the coefficient parameters to be estimated. Please refer to section 4.2 for more details of this model.

The estimated coefficients are to be interpreted as the direction and scale of the effect that the explanatory variables have on the *change of the likelihood* of the saving motives. A positive sign on an explanatory variable's coefficient indicates that the higher absolute value of a coefficient increases the likelihood that a household saves mainly for the short term. A negative sign shows the opposite effect, i.e. a household saves mainly for the long term.

In order to obtain marginal effect estimates, an ordered Probit model estimation is applied on the dataset in which four cross-sections are pooled, by allowing for clustering over time in the error term. In succession, marginal effects estimates on three saving motives are carried out respectively.

5.2.2 The seemingly unrelated regression (SUR) model

A seemingly unrelated regression (SUR) model is employed and this model accommodates four cross-sectional waves into a system, by allowing for correlations between the four waves. Time consistency of the estimated coefficients over the four waves can be tested.

The SUR model, in this study, specifies the t th of the T equations, where T denotes the waves 10~13 for the i th of N households to be given by:

$$SIT^{*}_{i10} = \alpha_{10}\hat{Y}^{p}_{i10} + \beta'_{i10}IU_{i10} + \gamma'_{10}IA_{i10} + \varphi'_{10}X_{i10} + \varepsilon_{i10},$$

$$SIT^{*}_{i11} = \alpha_{11}\hat{Y}^{p}_{i11} + \beta'_{i11}IU_{i11} + \gamma'_{11}IA_{i11} + \varphi'_{11}X_{i11} + \varepsilon_{i11},$$

$$SIT^{*}_{i12} = \alpha_{12}\hat{Y}^{p}_{i12} + \beta'_{i12}IU_{i12} + \gamma'_{12}IA_{i12} + \varphi'_{12}X_{i12} + \varepsilon_{i12},$$

$$SIT^{*}_{i13} = \alpha_{13}\hat{Y}^{p}_{i13} + \beta'_{i13}IU_{i13} + \gamma'_{13}IA_{i13} + \varphi'_{13}X_{i13} + \varepsilon_{i13},$$

The definitions of the variables are identical to those in the previous section. The four equations above have identical explanatory variables, and are linked by their disturbances. The SUR model is based on an assumption that there are correlations amongst disturbances of equations, that is, the equations are related as the errors ε in different equations are assumed to be correlated.

After the estimated coefficients are estimated in a SUR model, it is possible to test the consistency of the coefficients over the four waves. For example, when the coefficient vector of permanent income is to be tested, the null hypothesis is proposed as:

$\alpha_{10} = \alpha_{11} = \alpha_{12} = \alpha_{13}$, for which chi-squared statistics are applied. Given that such a hypothesis of a given variable is not rejected, the estimated coefficients exhibit the fluctuations over the four periods. However, in comparison with a panel-data estimation method, the SUR model estimations cannot measure a single long-term relationship. Moreover, they cannot explicitly measure the unobservable individual household effects.

5.3 EMPIRICAL ANALYSIS AND RESULTS – RANDOM-EFFECT ORDERED PROBIT MODEL

5.3.1 The whole sample level

Table 5.2 reports the estimation results from a random-effect ordered Probit regression model. The rho (ρ) values reported at the bottom of the tables indicate what proportion of the aggregate error term is captured by the random-effect error term, which denotes the unobserved household heterogeneity, and this is 46.6% at the whole sample level. Furthermore, results of the ordered Probit estimates and marginal effect estimates are reported in Table 5.3. In the general case, only the signs of the changes in the possibility of the rightmost category and that of the leftmost one are unambiguous (Greene, 2003); hence, only the marginal effect estimates on the changes in the probability of households' saving mainly for the long term and that of households' saving mainly for the short term, are interpreted.

To start with, the subjectively perceived aggregate risk, which is represented by 'financial expectations', does not have a significant effect on households' saving motives. The estimated results show that the coefficient of a lower aggregate risk is -0.031 and 0.067 for a higher aggregate risk, showing a tendency of saving mainly for the long term in the former case and one of saving mainly for the short term in the latter case. However, these coefficients are not statistically different from zero at the 10% significance level, and thus the relationship, which suggests that households with a worse-off financial expectation are more likely to save mainly for short-term precautionary reasons, is not evident. Therefore, this finding does not support the precautionary saving effect which is suggested by the buffer-stock model, as it posits that households that expect higher uncertainty/risk in the near future are supposed to accumulate wealth, to buffer short-term consumption fluctuation. Having a good current financial situation has a statistically significant effect on households' saving motives, as the households that report to be either 'doing alright' or 'living comfortably', are more likely to save mainly for the long term at the 1% significance level, with a coefficient -0.177; by contrast, a bad current financial situation is not found to be influential on determining households' saving motives. Recent financial experience, which is denoted by 'financial realisations', is not an evident determinant on households' saving motives.

As shown in Table 5.3, the marginal effect of having good current financial situation on the probability of households' saving mainly for the long term increases by 0.063 and that on the probability of households' saving mainly for the short term decreases by 0.057.

Two explanations are provided for the insignificant relationship between short-term uncertainty and the short-term saving motive. First, short-term uncertainty is not as influential as theoretically suggested, so as to enact households' precautionary motive, and make them more inclined to save mainly for the short term. Second, the idea of the 'missing precautionary saving effect' proposed by Laibson (1998, p886) suggests that a household with a hyperbolic discount function tends to self-impose liquidity constraint now on their accessibility to the short-term savings, in order to prevent himself/herself from splurging in the next period. Accordingly, households are averse to save for the short term. Moreover, saving for the long term is normally more highly valued than saving for the short term by households with a hyperbolic discount function. Consequently, as a result of this, either households are inclined to instant gratification from available liquidity or households prefer to save for the long term, and this makes the effect of precautionary saving insignificant. Whilst short-term precautionary saving effect is not evident here, there is no reason to rule out precautionary saving motive with the long-term uncertainty, as Carroll, Dynan, and Krane (p602, 2003) conclude that consumers, in particular when their discount function is hyperbolic, may want to hold a buffer stock, mainly in illiquid assets, against unemployment risk in the long term.

It is suggested that collinearity may exist amongst subjective financial evaluations, namely, financial expectations, financial realisations, and current financial status, which can distort the estimation results. For example, households who are in a good financial status can be more likely to have a positive financial expectation. Hence, robustness check is thus carried out: three sets of subjective financial evaluations - financial expectations, financial realisations, and current financial situations – enter the regression one set at a time, together with other explanatory variables. The effects of each set of financial evaluations can therefore be estimated respectively. Results of the model II, in Table 5.4, show that the subjective financial expectations remain uncorrelated with the tendency toward saving mainly for the short term, at the 10% significant level. Moreover, results of the model I exhibit that households in a good

financial status are more likely to save mainly for the long term; in addition, as can be seen from results of the model III, financial realisations do not have an influence on saving motives, at the 10% significance level. These results are consistent with the previous estimates of the full model. To sum up, this robustness check rules out the possibility of collinearity problem. Furthermore, the estimation results strengthen the previous argument that short-term precautionary saving effect is missing.

An implication of the quasi-hyperbolic life-cycle consumption model, is that consumers with a hyperbolic discount function are inclined to save for the long term and accumulate wealth in illiquid forms, such as housing wealth or pension wealth; also, they are less in favour of making short-term savings because the discount rate for the short term is greater than that for the long term. Thus, a relationship between homeownership/pension enrolment and a decrease in the possibility of households saving mainly for the short term can be a testable hypothesis supported by the quasi-hyperbolic life-cycle consumption model. Results show that the households that own housing wealth are more likely to save mainly for the long term, at the 1% significance level, with a coefficient of -0.165. The corresponding marginal effect estimates in Table 5.3 show that the probability of saving mainly for the long term increases by 0.048, whereas the probability of saving mainly for the short term decreases by 0.043. This relationship supports the quasi-hyperbolic consumption model. By contrast, the coefficient of pension enrolment is -0.065, but this is not statistically evident, at the 10% significance level; therefore, the effect of paying into a private pension is not influential on households' saving motives. These findings have the implication that the quasi-hyperbolic consumption model is robust only amongst homeowners.

The status of self-employment is associated with a relatively high financial risk, in the sense that the self-employed are more vulnerable to income losses, when their financial condition deteriorates and the fact that they are less likely to be covered by unemployment insurance. This leads to a hypothesis that the self-employed households are more likely to save for the short term due to having a stronger precautionary saving motive than employees. The estimated results show that the self-employed households are more likely to save mainly for the long term at the 10% significance level, with a coefficient of -0.143. As shown in Table 5.3, self-employment contributes to a marginal increase in the probability of saving mainly for the long term by 0.030, which is higher

than a marginal decrease in the probability of saving mainly for the short term, i.e. 0.026. This finding shows that the self-employed have a stronger long-term saving motive than employees, and this suggests the possibility that the self-employed make long-term savings for retirement and uncertainty in the long term future. Having said so, this coefficient emerges as only weakly evident.

Occupations characterise employment-specific effects, such as a certain risk related to a specific employment type. As shown in Table 5.1, the income variability of the 'plants & machine operatives' sector is the lowest amongst those sectors with average income level below £30000, such as the 'associate professional & technical' sector, the 'craft related' sector, the 'personal & protective services' sector, and the 'sales' sector. Of the rest of the groups – the 'managers & administrators' sector, the 'professional' sector, and the 'clerical & secretarial' sector, the 'clerical & secretarial' sector has the lowest income variability. The indicator for occupation categories was applied as a proxy for income uncertainty in the literature; however, the estimation results can be weakened by the, so-called, self-selection problem. The problem arises in that people who are more risk-averse tend to work in occupations which are less risky. However, advanced work is required to identify the self-selection problem, because whilst some people are free to choose their jobs, others only have access to jobs with higher risk.

Table 5.1: Descriptive statistics of household income (£/year) by occupation groups

Occupation group	Mean	Standard Deviation
Managers & administrators	43153.62	24811.51
Professional	46217.44	25717.88
Associate professional & technical	27630.36	16861.51
Clerical & secretarial	35879.88	24240.28
Craft related	29651.08	14495.56
Personal & protective services	24893.37	15206.87
Sales	27314.8	17021.26
Plants & machine operatives	23145.68	13805.97

The estimated results exhibit that, compared with those who in the 'plants & machine operatives' occupation[89], households in the 'craft related' or 'personal & protective services' occupations, are more likely to save mainly for the short term at the 1% significance level, with coefficients of 0.559 and 0.599, respectively. Moreover, households in the 'sales' sector are more likely to save mainly for the short term at the 5% significance level, with a coefficient of 0.516. To some extent, these results can be

[89] This is the dummy base for occupation groups.

explained by the higher income variability within these three occupational groups. Households in the 'clerical & secretarial' sector are more likely to save for the short term at the 10% significance level, with a coefficient of 0.362. The relationships between the short-term saving motive and jobs that are inherently risky are seen to be robust, which supports the idea of precautionary saving behaviour.

Estimates of marginal effects of each occupation type are reported in Table 5.3. Compared with those in the 'plants & machine operatives' sector, for the households in the 'managers & administrators', the 'professional', the 'associate professional & technical', the 'clerical & secretarial', or the 'craft related' sectors, the probabilities of saving mainly for the long term decrease by 0.099, 0.114, 0.113, 0.131, and 0.189, respectively. For these households, the possibilities of saving mainly for the short term increase by 0.091, 0.109, 0.108, 0.125, and 0.182, respectively, and these are in greater magnitudes. By contrast, for those in the 'personal & protective services' or the 'sales' sector, the probabilities of saving mainly for the short term increase by 0.188 and 0.157, respectively, which are in greater magnitudes than the decreases in the probability of saving mainly for the long term.

As shown in Table 5.2, different gender type affects heads of households' saving motives. Female heads of households are more likely to save mainly for the short term at the 1% significance level than males, with a coefficient of 0.379. As shown in Table 5.3, the marginal decrease in the probability of saving mainly for the long term, 0.116, is in greater magnitude than the marginal increase in the probability of saving mainly for the short term, 0.109. This implies that females are more likely to engage themselves in short-term precautionary saving as well as less likely to save mainly for the long term, than males. An explanation is proposed: in a household, the female is mainly in charge of the management of family expenditures over a short-term horizon, such as paying bills, managing children's education fees, monthly budget allocations, etc.; such tendency is even enhanced in the situation that the female is the head of a household.

Educational attainment is a key indicator for a household's socioeconomic status. Results indicate that, compared with those who have finished education below A level, households, who have a postgraduate degree, have a first degree, or have had a college education, are more likely to save mainly for the long term at the 1% significance level,

with coefficients of -0.511, -0.344, and -0.215, respectively. Those who have attained A-level education are more likely to save mainly for the long term at the 10% significance level, with a coefficient of -0.126. For the four groups, marginal increases in the probability of saving mainly for the long term – 0.141, 0.092, 0.059, and 0.032, respectively – are in greater magnitudes than marginal decreases in the probability of saving mainly for the short term – 0.110, 0.077, 0.051, and 0.027, respectively. This shows that having undertaken higher education enhances households' long-term saving motive, and strongly imply that such households are more likely to save to this end. People with higher education attainment are usually more prudent than low-educated people, so are more aware of long-term savings. Furthermore, highly-educated people usually have jobs with better payment and occupational welfare coverage, and as a consequence, are less concerned with needs and risk in the short-term future.

Estimated permanent income is considered as a proxy for a household's wealth level. The results show a negative coefficient of permanent income, indicating that households with higher permanent income, or wealth, are more likely to save mainly for the long term at a 1% significance level, with a coefficient of -6.00e-06. As reported in Table 5.3, the marginal increase in the probability of saving mainly for the long term is 1.56e-06, which is in greater magnitude than the marginal decrease in the probability of saving mainly for the short term – 1.37e-06. This finding also suggests that households with less wealth concern themselves more with short-term precautionary savings, than those with more wealth. In comparison, Guariglia (2001) did not find that permanent income was influential on households' saving ratios; Carroll, Dynan, and Krane (2003) found that households in the lowest permanent income group did not engage in precautionary saving, yet precautionary behaviour became significant once households' incomes increased.

It is reasonable to presume that young cohorts are more likely to engage in precautionary saving because they are easily liquidity constrained. The variables 'age' and 'age^2' represent age effects over the life cycle, and age effects are not significant on influencing households' saving motives, at the whole sample level.

It is sensible to think that households with joint income sources are less influenced by a financial shock, and they tend to have a lower precautionary saving motive and are less concerned with short-term saving as a consequence (Carroll, Dynan, and Krane, 2003). The estimated results show that households with a spouse/partner employed, are more likely to save mainly for the short term at the 1% significance level, with a coefficient of 0.160. As can be seen in Table 5.3, the marginal increase in the probability of saving mainly for the short term is in smaller magnitude than the marginal decrease in the probability of saving mainly for the long term. This finding seems to go against precautionary saving theory.

Results here show that family size has a significant influence on saving motives, at the 10% significance level, with coefficients of -0.186 and -0.142 regarding the dummy variable of 1-2 members and that of 3-4 members, respectively. As shown in Table 5.3, for both cases, the marginal increases in the probability of saving mainly for the long term, 0.051 and 0.036 respectively, emerge in greater magnitude than marginal decreases in the probability of saving mainly for the short term, 0.045 and 0.032 respectively. These results suggest that the heads of households with more family members have a stronger precautionary saving motive for the short term.

Compared with those living in South East, households living in the West Midlands are more likely to save mainly for the short term, at the 1% significance level, with a coefficient of 0.328; apart from this, there is no other evidence of a residential effect. Table 5.3 reports that the marginal increase in the probability of saving mainly for the short term, 0.094, is smaller than the marginal decrease in the probability of saving mainly for the long term, 0.098. This finding may imply that either the residents in the West Midlands are more concerned with short-term saving, or are more precautionary, or that the local economic situation in this area is less stable than in other British regions.

Table 5.2: Random effect ordered Probit estimates on saving motives – Whole sample

		Whole sample	
Independent Variables	*Mean*	*Coef.*	*Std Dev.*
Permanent income	34735.92	-6.00e-06***	1.40e-06
Financial situation (Neutral)			
Good	0.849	-0.177***	0.055
Bad	0.017	-0.054	0.148
Financial expectation (About the same)			
Better-off	0.318	-0.031	0.040
Worse-off	0.073	0.067	0.067
Financial realisation (About the same)			
Better than last year	0.397	-0.004	0.039
Worse than last year	0.142	-0.033	0.054
Private pension enrolment (otherwise)	0.270	-0.065	0.046
Homeownership (otherwise)	0.864	-0.165***	0.061
Female (Male)	0.217	0.379***	0.064
Age	42.448	-0.025	0.019
Age squared	1903.721	0.000	0.000
Education (Less than A level)			
Higher than first degree	0.059	-0.511***	0.109
First degree	0.171	-0.344***	0.074
Some college	0.342	-0.215***	0.055
A Level	0.118	-0.126*	0.074
Married/Cohabiting (Otherwise)	0.736	-0.035	0.079
Self-employed (Employee)	0.120	-0.143*	0.080
Spouse/partner employed (Otherwise)	0.601	0.160***	0.062
Full-time employed (Part-time employed)	0.924	0.057	0.077
Occupation (Plant & machine operatives)			
Managers & Administrators	0.260	0.274	0.192
Professional	0.093	0.309	0.201
Associate professional & Technical	0.134	0.303	0.197
Clerical & Secretarial	0.182	0.362*	0.195
Craft related	0.246	0.559***	0.193
Personal & Protective services	0.023	0.599***	0.229
Sales	0.052	0.516**	0.208
With children (Without children)	0.402	0.043	0.065
Household size (5 members or more)			
1-2 members	0.490	-0.186*	0.100
3-4 members	0.429	-0.142*	0.079

Residential area (South East)			
Greater London	0.052	-0.132	0.113
South West	0.055	-0.101	0.114
East	0.075	-0.054	0.101
West Midlands	0.049	0.328***	0.117
Greater Manchester	0.024	-0.006	0.153
North West	0.043	0.134	0.124
Yorkshire & Humberside	0.058	-0.072	0.110
Tyne & Wear	0.041	0.204	0.126
Wales	0.143	0.038	0.085
Scotland	0.201	-0.082	0.080
Northern Ireland	0.131	-0.086	0.087
Year dummy (2003-2004)			
2000-2001		-0.133***	0.045
2001-2002		-0.149***	0.043
2002-2003		-0.137***	0.043
_cut 1		-1.474***	0.459
_cut 2		-0.484	0.458
Number of observations		7763	
Log likelihood		-7780.878	
LR Chi square		363.61	
P-value		0.0000	
ρ (rho)		0.466	

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Note: The base dummy for each dummy variable is specified in bracket.

Table 5.3: Ordered Probit estimates and marginal effect estimates

	Ordered Probit estimation		Marginal effect estimation					
	Ordered probit model		Saving mainly for the long term		Saving for both long-term and short-term		Saving mainly for the short term	
Independent Variables	*Coef.*	*Std Dev.*	dy_{LT} / dx [90]	Standard error	dy_{both} / dx	Standard error	dy_{ST} / dx	Standard error
Permanent income	-3.99e-06***	7.15e-07	1.56e-06***	0.000	-1.90e-07***	0.000	-1.37e-06***	0.000
Financial situation (Neutral)								
Good	-0.162***	0.024	0.063***	0.010	-0.005***	0.001	-0.057***	0.009
Bad	-0.036	0.125	0.014	0.049	-0.002	0.007	-0.012	0.042
Financial expectation (About the same)								
Better-off	-0.009	0.030	0.003	0.012	-0.0004	0.001	-0.003	0.010
Worse-off	0.056	0.036	-0.022	0.014	0.002**	0.001	0.019	0.013
Financial realisation (About the same)								
Better than last year	0.008	0.021	-0.003	0.008	0.0004	0.001	0.003	0.007
Worse than last year	-0.051***	0.006	0.020***	0.003	-0.003***	0.0003	-0.017***	0.002
Private pension enrolment (otherwise)	-0.057	0.037	0.022	0.015	-0.003	0.002	-0.019	0.013
Homeownership (otherwise)	-0.123***	0.043	0.048***	0.016	-0.004***	0.001	-0.043***	0.015
Female (Male)	0.303***	0.038	-0.116***	0.014	0.007***	0.002	0.109***	0.014
Age	-0.020	0.012	0.008	0.005	-0.001	0.001	-0.007*	0.004
Age squared	0.0001	0.0001	-0.000	0.000	6.00e-06	0.00001	0.000	0.000
Education (Less than A level)								
Higher than first degree	-0.354***	0.008	0.141***	0.003	-0.030***	0.002	-0.110***	0.002
First degree	-0.232***	0.040	0.092***	0.016	-0.015***	0.003	-0.077***	0.013
Some college	-0.150***	0.027	0.059***	0.010	-0.008***	0.002	-0.051***	0.009
A Level	-0.080**	0.034	0.032**	0.014	-0.004**	0.002	-0.027**	0.011
Married/Cohabiting (Otherwise)	-0.005	0.044	0.002	0.017	-0.00003	0.002	-0.002	0.015
Self-employed (Employee)	-0.077**	0.039	0.030**	0.015	-0.004*	0.002	-0.026**	0.013
Spouse/partner employed (Otherwise)	0.108***	0.024	-0.042***	0.009	0.005	0.001	0.037***	0.008
Full-time employed (Part-time employed)	0.044	0.038	-0.017	0.015	0.002	0.002	0.015	0.013
Occupation (Plant & machine operatives)								

[90] y_{LT} denotes the probability of saving mainly for the long term, y_{ST} for saving mainly for the short term, and y_{both} for both long-term and short-term equally.

Managers & Administrators	0.257**	0.128	-0.099**	0.048	0.008***	0.001	0.091*	0.047
Professional	0.300***	0.105	-0.114***	0.037	0.004	0.004	0.109***	0.040
Associate professional & Technical	0.298***	0.116	-0.113***	0.041	0.005*	0.003	0.108**	0.044
Clerical & Secretarial	0.346**	0.141	-0.131***	0.050	0.006*	0.004	0.125**	0.054
Craft related	0.502***	0.099	-0.189***	0.034	0.007	0.005	0.182***	0.038
Personal & Protective services	0.498***	0.122	-0.180***	0.041	-0.008	0.010	0.188***	0.049
Sales	0.422***	0.145	-0.156***	0.049	-0.001	0.010	0.157***	0.058
With children (Without children)	0.047**	0.020	-0.018**	0.008	0.002***	0.001	0.016**	0.007
Household size (5 members or more)								
1-2 members	-0.131***	0.047	0.051***	0.018	-0.006***	0.002	-0.045***	0.016
3-4 members	-0.093*	0.048	0.036*	0.019	-0.005**	0.002	-0.032*	0.017
Residential area (South East)								
Greater London	-0.100**	0.042	0.039**	0.017	-0.006*	0.003	-0.033**	0.014
South West	-0.042	0.047	0.017	0.019	-0.002	0.003	-0.014	0.016
East	-0.012	0.030	0.005	0.012	-0.001	0.001	-0.004	0.010
West Midlands	0.258***	0.046	-0.098***	0.017	0.004**	0.002	0.094***	0.018
Greater Manchester	0.027	0.073	-0.010	0.028	0.001	0.003	0.009	0.025
North West	0.094	0.071	-0.037	0.027	0.003*	0.002	0.033	0.025
Yorkshire & Humberside	-0.025	0.045	0.010	0.018	-0.001	0.002	-0.009	0.015
Tyne & Wear	0.153**	0.062	-0.059**	0.024	0.004***	0.001	0.054**	0.023
Wales	0.031	0.023	-0.012	0.009	0.001	0.001	0.011	0.008
Scotland	-0.044	0.029	0.017	0.011	-0.002	0.001	-0.015	0.010
Northern Ireland	-0.046*	0.025	0.018*	0.010	-0.002	0.002	-0.016*	0.008

Number of observations	7763
Log pseudolikelihood	-8108.967
Wald chi square	16.87
P-value	0.001
Pseudo R^2	0.031

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Table 5.4: Random effect ordered probit estimates for robustness check on collinearity

	Model I – Current financial status		Model II – Financial expectations		Model III – Financial realisation	
Independent Variables	*Coefficient*	*Standard Devi.*	*Coefficient*	*Standard Devi.*	*Coefficient*	*Standard Devi.*
Permanent income	-6.01e-06***	1.40e-06	-6.41e-06***	1.40e-06	-6.39e-06***	1.40e-06
Financial situation (Neutral)						
Good	-0.171***	0.054	--	--	--	--
Bad	-0.060	0.147	--	--	--	--
Financial expectation (About the same)						
Better-off	--	--	-0.030	0.039	--	--
Worse-off	--	--	0.072	0.067	--	--
Financial realisation (About the same)						
Better than last year	--	--	--	--	-0.022	0.038
Worse than last year	--	--	--	--	-0.001	0.053
Private pension enrolment (Otherwise)	-0.066	0.046	-0.067	0.046	-0.067	0.046
Homeownership (Otherwise)	-0.163***	0.061	-0.174***	0.061	-0.173***	0.061
Female (Male)	0.383***	0.063	0.378***	0.064	0.381***	0.064
Age	-0.025	0.019	-0.024	0.019	-0.025	0.019
Age squared	0.0001	0.0002	0.0001	0.0002	0.0001	0.0002
Education (Less than A level)						
Higher than first degree	-0.511***	0.108	-0.512***	0.109	-0.509***	0.109
First degree	-0.344***	0.074	-0.348***	0.074	-0.345***	0.074
Some college	-0.217***	0.055	-0.214***	0.055	-0.214***	0.055
A Level	-0.127*	0.074	-0.131*	0.074	-0.130*	0.074
Married/Cohabiting (Otherwise)	-0.035	0.079	-0.040	0.079	-0.040	0.079
Self-employed (Employee)	-0.145*	0.080	-0.143*	0.080	-0.145*	0.080
Spouse/partner employed (Otherwise)	0.161***	0.062	0.161***	0.062	0.162***	0.062
Full-time employed (Part-time employed)	0.056	0.077	0.051	0.077	0.052	0.077
Occupation (Plant & machine operatives)						
Managers & Administrators	0.275	0.192	0.256	0.193	0.255	0.193
Professional	0.310	0.201	0.289	0.201	0.289	0.201
Associate professional & Technical	0.304	0.197	0.292	0.197	0.292	0.197
Clerical & Secretarial	0.363*	0.195	0.349*	0.195	0.349*	0.195
Craft related	0.560***	0.193	0.551***	0.193	0.549***	0.193
Personal & Protective services	0.598***	0.229	0.591***	0.229	0.588***	0.229
Sales	0.517**	0.208	0.502**	0.208	0.502**	0.208
With children (Without children)	0.043	0.065	0.045	0.065	0.044	0.065
Household size (5 members or more)						

1-2 members	-0.187*	0.100	-0.200**	0.100	-0.201**	0.100
3-4 members	-0.142*	0.079	-0.148*	0.079	-0.149*	0.079
Residential area (South East)						
Greater London	-0.131	0.113	-0.129	0.113	-0.128	0.113
South West	-0.098	0.114	-0.101	0.114	-0.099	0.115
East	-0.056	0.101	-0.061	0.101	-0.064	0.101
West Midlands	0.330***	0.117	0.325***	0.117	0.325***	0.117
Greater Manchester	-0.010	0.153	-0.012	0.153	-0.018	0.153
North West	0.135	0.124	0.134	0.125	0.132	0.125
Yorkshire & Humberside	-0.072	0.110	-0.078	0.111	-0.079	0.111
Tyne & Wear	0.207*	0.126	0.200	0.126	0.202	0.126
Wales	0.038	0.085	0.040	0.085	0.038	0.085
Scotland	-0.081	0.080	-0.081	0.080	-0.083	0.080
Northern Ireland	-0.084	0.087	-0.091	0.087	-0.095	0.087
Year dummy (2003-2004)						
2000-2001	-0.135***	0.045	-0.123***	0.045	-0.124***	0.045
2001-2002	-0.149***	0.043	-0.145***	0.043	-0.143***	0.043
2002-2003	-0.138***	0.043	-0.135***	0.043	-0.135***	0.043
_Cut 1	-1.444***	0.456	-1.347***	0.457	-1.351***	0.457
_Cut 2	-0.454	0.455	-0.356	0.436	-0.361	0.456
ρ (rho)	0.466***	0.018	0.468***	0.018	0.468***	0.018
Number of observations	7763		7763		7763	
Log likelihood	-7782.052		-7786.161		-7787.034	
LR Chi square	361.26		353.04		351.30	
P-value	0.000		0.000		0.000	

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Note: The base dummy for each dummy variable is specified in bracket.

5.3.2 At the sub-sample level

In this section, the comparison between homeowners and private pension participants is discussed. This section aims to investigate, for households who save money in illiquid forms or save regularly through an external mechanism for retirement, how their saving motives change with respect to the independent variables. The second and the third panels of Table 5.5 report the estimated coefficients of homeowners and pension participants. Of the whole sample, homeowners make up 86.4% and private pension participants 27%.

Amongst homeowners, those who have a good financial situation are more likely to save mainly for the long term at the 1% significance level, with a coefficient of -0.168. In addition, private pension participants who have a good financial situation are also more likely to save mainly for the long term at the 10% significance level, with a coefficient of -0.196. In comparison, such an effect is robust for homeowners, although the scale of effect can be greater for pension participants, according to the coefficients. On the other hand, for homeowners and private pension participants, financial expectations, indicators for aggregate risk, do not appear to have a statistically significant impact on saving motives. Therefore, short-term precautionary saving effect cannot be found here. Moreover, financial realisations, indicators for recent financial experience, are not influential on the saving motives of either group.

This section discusses the impact of private pension enrolment on homeowners and that of homeownership on private pension participants. Around 28% of the homeowners have also paid into a private pension scheme; results show that, amongst homeowners, saving preferences of a long-term horizon and a short-term horizon do not vary between those who are accumulating private pension wealth and those who are not. Around 90% of pension participants possess housing wealth; results show that the effect of homeownership is not evident on changes in the saving motives of pension participants.

Self-employment status does not have an impact on the saving motives of homeowners. By contrast, self-employed pension participants are more likely to save mainly for the long term at the 10% significance level than employee pension participants, with a coefficient of -0.224.

Occupational effects are evident for homeowners but not private pension participants. Regarding occupational effects, homeowners in some specific occupations which feature high volatility of income flow or high risk, such as the 'craft related', 'personal & protective services', and 'sales' sectors, are more likely to save mainly for the short term at the 5% significance level than those in 'plants & machine operatives' sector, with coefficients of 0.600, 0.729, and 0.542, respectively. Homeowners in the 'clerical & secretarial' sector are more likely to save mainly for the short term at the 10% significance level, with a coefficient of 0.422. On the other hand, occupational effect emerges to be insignificant on pension participants' saving motives.

Female homeowners are more likely to save for the short term at the 1% significance level, than male homeowners, with a coefficient of 0.414. Female pension participants are also more likely to save for the short term at the 1% significance level, than their male equivalents, with a coefficient of 0.374. Combining these two findings, females who own illiquid wealth and have been accumulating pension wealth, are still more likely to save for the short term than their male counterparts. This suggests the possibility that females, in general, have a stronger inclination to save for the short term than males, and females thus have a stronger short-term precautionary motive than males.

For both homeowners and private pension participants, the effects of educational attainment emerge as strongly significant. Homeowners, who have a postgraduate degree, a first degree, or have had some college education, are more likely to save mainly for the long term at the 1% significance level, with coefficients of -0.460, -0.318, and -0.197, respectively. For private pension participants, the coefficients are -0.779, -0.369, and -0.307, respectively, at the 1% significance level. For both groups, higher education has enhancing effects on long-term saving motives; moreover, the effects appear greater in scale on pension participants than on homeowners.

Homeowners who have higher permanent income, i.e. wealth level, are more likely to save mainly for the long term at the 1% significance level, with a coefficient of -6.82e-06; private pension participants with high wealth levels (permanent income) are more likely to save mainly for the long term at the 5% significance level, with a coefficient of

-4.92e-06. Comparing the two, such an effect is more profound for homeowners than for private pension participants.

Homeowners with few members are more likely to save mainly for the long term at the 5% significance level, with coefficients of -0.266 where there are 1-2 members and -0.192 for 3-4 members. On the other hand, effects of household size do not emerge as significant for private pension participants.

Homeowners with joint income sources are more likely to save mainly for the short term at the 1% significance level, with a coefficient of 0.187, and equivalent pension participants are more likely to save mainly for the short term at the 10% significance level, with a coefficient of 0.221.

Homeowners living in the West Midlands are more likely to save for short term at the 1% significance level than those in any other residential area. Pension participants living in the 'North West' region are more likely to save mainly for the short term, at the 10% significance level.

Table 5.5: Random effect ordered Probit estimates on saving motives – Subgroups

	Homeowners			Pension participants		
Independent Variables	*Mean*	*Coef.*	*Std Dev.*	*Mean*	*Coef.*	*Std Dev.*
Permanent income	36512.600	-6.82e-06***	1.49e-06	37059.340	-4.92e-06**	2.04e-06
Financial situation (Neutral)						
Good	0.863	-0.168***	0.062	0.867	-0.196*	0.115
Bad	0.015	-0.179	0.168	0.014	-0.331	0.308
Financial expectation (About the same)						
Better-off	0.308	-0.017	0.043	0.314	-0.112	0.079
Worse-off	0.076	0.060	0.072	0.069	0.091	0.139
Financial realisation (About the same)						
Better than last year	0.386	-0.006	0.042	0.388	0.118	0.078
Worse than last year	0.145	-0.007	0.058	0.152	0.104	0.105
Pension enrolment (Otherwise)	0.284	-0.043	0.049	--	--	--
Homeownership (Otherwise)	--	--	--	0.908	0.048	0.138
Female (Male)	0.189	0.414***	0.073	0.135	0.374***	0.138
Age	42.863	-0.037*	0.021	43.103	-0.058	0.038
Age squared	1935.061	0.0003	0.0002	1955.750	0.0005	0.0004
Education (Less than A level)						
Higher than first degree	0.061	-0.460***	0.117	0.049	-0.779***	0.222
First degree	0.178	-0.318***	0.080	0.179	-0.369***	0.139
Some college	0.35	-0.197***	0.061	0.358	-0.307***	0.104
A Level	0.123	-0.094	0.080	0.112	-0.083	0.144
Married/Cohabiting (Otherwise)	0.77	-0.022	0.088	0.787	-0.089	0.157
Self-employed (Employee)	0.121	-0.141	0.087	0.257	-0.224*	0.116
Spouse/partner employed (Otherwise)	0.631	0.187***	0.066	0.637	0.221*	0.115
Full-time employed (Part-time employed)	0.935	0.121	0.089	0.956	0.174	0.181
Occupation (Plant & machine operatives)						
Managers & Administrators	0.277	0.343	0.245	0.317	0.025	0.279
Professional	0.095	0.354	0.253	0.108	0.233	0.302
Associate professional & Technical	0.128	0.324	0.249	0.069	-0.009	0.305
Clerical & Secretarial	0.187	0.422*	0.247	0.158	-0.027	0.291
Craft related	0.238	0.600**	0.245	0.224	0.267	0.287
Personal & Protective services	0.016	0.729**	0.294	0.012	0.283	0.436
Sales	0.05	0.542**	0.260	0.090	0.381	0.301
With children (Without children)	0.411	0.035	0.071	0.410	-0.040	0.135
Household size (5 members or more)						
1-2 members	0.472	-0.266**	0.108	0.455	-0.315	0.195

3-4 members	0.442	-0.192**	0.085	0.450	-0.018	0.146
Residential area (South East)						
Greater London	0.047	-0.204	0.130	0.046	0.047	0.221
South West	0.053	-0.059	0.127	0.064	0.078	0.207
East	0.072	-0.164	0.114	0.095	-0.007	0.177
West Midlands	0.050	0.333***	0.127	0.063	0.251	0.203
Greater Manchester	0.025	-0.094	0.165	0.020	-0.262	0.308
North West	0.045	0.069	0.133	0.041	0.413*	0.236
Yorkshire & Humberside	0.059	-0.112	0.122	0.062	-0.098	0.201
Tyne & Wear	0.041	0.145	0.139	0.039	0.311	0.243
Wales	0.148	-0.010	0.093	0.139	0.037	0.159
Scotland	0.196	-0.115	0.088	0.159	0.039	0.154
Northern Ireland	0.136	-0.142	0.095	0.125	-0.038	0.165
Year dummy (2003-2004)						
2000-2001		-0.168***	0.049		-0.224**	0.093
2001-2002		-0.153***	0.047		-0.160*	0.089
2002-2003		-0.150***	0.046		-0.076	0.087
_cut 1		-1.540***	0.536		-2.086**	0.921
_cut 2		-0.528	0.535		-1.109	0.919
Number of observations		6704			2098	
Log likelihood		-6685.627			-2066.808	
LR Chi square		284.10			112.76	
P-value		0.0000			0.0000	
ρ (rho)		0.474			0.474	

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Note: The base dummy for each dummy variable is specified in bracket

5.3.3 Summary

Short-term precautionary saving effect, which is defined as saving for short-term aggregate risk in this study, is not found to be significant in the estimation results at the whole sample level or even in the two subgroups. Two explanations are proposed: first, households may have accumulated enough wealth to buffer the short-term risk; second, this missing correlation between the propensity to save for the short term and the perceived aggregate risk supports the quasi-hyperbolic consumption model, as this implies that the precautionary saving effect may be missing. In addition, there is another finding that goes against the insight of precautionary saving motive, which is that households with joint income sources have an inclination to save for the short term. Nevertheless, it is observed at the whole sample level and in the homeowner group that an occupational effect is evident, showing that households in the sectors with unstable income streams have stronger short-term saving motives, and this suggests the possibility of precautionary saving behaviour. But this is not observed amongst pension participants.

Considering the whole sample level, 86.4% are homeowners and 27% are private pension participants. At the whole sample level, pension enrolment does not have a significant impact on saving motives, but homeowners are more likely to save mainly for the long term than non-homeowners. This finding about homeownership supports the quasi-hyperbolic consumption model in that the hyperbolic consumers, as they are presumably aware of their self-control problems, choose to self-impose constraint on accessing liquid assets, by accumulating wealth in illiquid forms (Laibson 1998). In addition, hyperbolic consumers have a preference for saving for the long term to saving for the short term. Housing wealth can distinguish itself from pension wealth as it can also serve as a type of precautionary savings to buffer uncertainty in the long term. Previous literature indicated that housing wealth also reflected precautionary wealth. Firstly, Laibson (1997) suggested that consumers with hyperbolic discount factors would hold illiquid wealth to buffer income risk in the long run. Secondly, Carroll and Samwick (1998) proposed that illiquid assets may not be undesirable buffers, if the consumers' concern was a high cost but low probability event, such as job loss. Carroll, Dynan, and Krane (2003) found amongst U.S. households that home equity was a driving force behind the relationship between unemployment risk and total net worth

and not net financial wealth. Having said so, the distinction of homeownership and private pension participants does not emerge as evident on the saving motives of homeowners and private pension participants.

Socioeconomic factor – gender difference, educational attainment, and wealth level – have robust impacts on households' saving motives at the whole sample level and in the two subgroups.

5.4 EMPIRICAL ANALYSIS AND RESULTS – THE SEEMINGLY UNRELATED REGRESSION (SUR) MODEL

As generally understood, the cross-sectional estimation can easily fail to distinguish the effects as a result of changes over time, which can cause bias in the estimation. A SUR model has the advantage over a simple cross-sectional estimation method, in that, when obtaining cross-sectional estimations, this model takes into account unspecified correlations during different periods in this study. Moreover, a SUR model can be employed on cross-sections with time-series data, by taking account of unobserved household heterogeneity without imposing any assumption on the distribution of these factors. An exogenous macroeconomic shock, such as a change in policy, can emerge as effective over three years, and this can be implicitly controlled by the correlations between equations. In addition, if a household makes a purchase of durable goods in a certain year, this has an effect on its current saving behaviour and is likely to emerge in the previous and successive years.

This approach allows for an investigation into whether a common framework captures a steady trend for the four different waves (years) of this study, which is a test on the time consistency of coefficients over the waves. The purpose for testing the hypothesis of time consistency of coefficients is to examine whether the effects of each independent variable, which are obtained in a SUR model, are consistent in all equations, i.e. the four waves in this study. If the hypothesis is not rejected, the time consistency of the coefficients of a given independent variable holds, and this further indicates that the robustness of its influence can be accepted.

5.4.1 The whole sample level

The results of the estimations over the four waves are reported in Table 5.6, and those of the hypothesis for time consistency, are shown in Table 5.7.

The shares of households who consider their financial situations as positive vary between 80.7% in wave 10 and 88.1% in wave 13, showing a temporally upward trend for the four waves. The results show that having a good current financial situation is

associated with an increase in the likelihood of saving mainly for the long term, at the 5% significance level, in waves 10 and 11, with coefficients of -0.190 and -0.204, respectively. This shows that households who consider themselves to be 'living comfortably' or 'doing all right' financially, tend to have a stronger long-term saving motive. Such a tendency is more evident in waves 10 and 11 than in waves 12 and 13; however, the hypothesis of time consistency is not rejected, at the 10% significance level, showing that this tendency is consistent over the four waves.

Subjectively perceived aggregate short-term risk, which is featured by the dummy variable 'financial expectations', emerges as having no significant impact on affecting households' short-term saving motive over the four waves, as the coefficients of positive and negative financial expectation are not evident, at the 10% significance level. The precautionary saving effect is missing in that a negative financial expectation does not make households more inclined to save mainly for the short term. This is consistently observed throughout the four waves as is seen in Table 5.7, as the hypothesis of the coefficients being consistent over time is not rejected.

Recent financial experience, which is characterised by the difference between this year's financial situation and last year's situation, does not have any evident impact on changes in saving motives. No rejection of the hypothesis of time consistency confirms that this finding is stable over the four waves (see Table 5.7).

The relationship between a household engaging in homeownership and an increase in the likelihood of its saving mainly for the long term, is observed at the 5% significance level in wave 10 and at the 10% level in wave 12, with coefficients of -0.191 and -0.173 respectively. These findings show that homeowners are more likely to save discretionarily mainly for the long term, than non-homeowners. This suggests that households' holding of housing wealth mitigates their precautionary motive in making savings for short-term purposes. Such a pattern emerges as evident in waves 10 and 12, but not in waves 11 and 13; nevertheless, this is consistent over the four waves because the hypothesis of time consistency is not rejected.

It is only found in wave 10 that households who have paid into a private pension scheme are more likely to save mainly for the long term, at the 5% significance level,

with a coefficient of -0.143. This relationship is not evident in the other three waves. However, the hypothesis of time consistency is not rejected, showing that the estimated influence of pension enrolment is stable over the four waves. The relationship between households' inclination towards long-term saving and pension enrolment, suggests that those who have been regularly saving for retirement are more inclined to saving for the long term and are less precautionary with respect to short-term purposes, than their counterparts.

It is proposed that these findings provide evidence to support the quasi-hyperbolic consumption model. This is because hyperbolic households' saving motive for a long-term purpose is more profound than for the short term, as a result of their inconsistent time preferences. Moreover, illiquid wealth, like housing wealth, and external saving mechanisms, such as a private pension scheme, are favoured by these households because these saving instruments help them manage their saving for the long term, as the saved money is usually not accessible in the short term or costly to gain access to.

Being self-employed does not appear to have any evident impact on households' saving motives, and this is a constant finding over the four waves, in that the hypothesis of time-consistency is not rejected. However, in the previous panel-data estimations, self-employed households were found to be more likely to save mainly for the long term, at the 10% significance level, than employees.

The panel-data estimations in the previous section reported that the households in the 'craft related', 'personal & protective services', or 'sales' occupations, are more likely to save mainly for the short term at the 5% significance level. However, some variations in the occupational effects can be seen over the four waves. To start with, the occupational effect is missing in wave 12. Secondly, compared with those in the 'plants & machine operatives' sector, households in the 'craft related' sector are more likely to save mainly for the short term, at the 5% significance level in waves 10 and 13, and at the 10% significance level in wave 11, with coefficients of 0.578, 0.801, and 0.438, respectively. Households in the 'personal & protective services' sector are more likely to save mainly for the short term, at the 5% significance level, in waves 10 and 11, with coefficients of 0.735 and 0.652, respectively. Households in the 'sales' sector are more likely to save mainly for the short term at the 5% significance level in wave 10 and at

the 10% level in wave 13, with coefficients of 0.667 and 0.696, respectively. By contrast, it is only observed in wave 13 that such occupations as 'managers & administration', 'professional', and 'associate professional & technical', which have higher income variability as well as significantly higher income level than those in 'plants and machine operatives' sector (shown in Table 5.1), are associated with an increase in the likelihood of saving mainly for the short term at the 10% significance level, with coefficients of 0.643, 0.673, and 0.676. These findings are only weakly evident, and thus I propose they may be a result of unobserved effects occurring only in wave 13. Households in the 'clerical and secretarial' sector are more likely to save mainly for the short term at the 10% significance level in wave 10 and at the 5% level in wave 13, with coefficients of 0.423 and 0.797, respectively. The hypothesis of time consistency is not rejected for any occupational sector, thus showing that the occupational effect on saving motives is stable over time (see Table 5.7).

Despite the variations mentioned above, it can be seen that, within a given wave, the scales of the effects are larger and more evident in the 'craft related', 'personal & protective services', and 'sales' sectors than in the other occupational groups. This shows that households in these occupations are more precautionary than the rest.

Females are more likely to save mainly for the short term than males at the 1% significance level in all of the waves, with coefficients of 0.245, 0.378, 0.237, and 0.347, respectively. The gender effect is robust and its strength is consistent in all the four waves. This suggests that the short-term precautionary motive is more profound in females than in males.

Educational attainment of heads of households has significant influence on their saving motives. Being consistent with the previous panel-data estimates, heads of household with a postgraduate degree, are more likely to save mainly for the long term, at the 1% and 5% significance levels over the four waves, with coefficients of -0.328, -0.361, -0.356, and -0.358, consecutively. Those with a first degree are more likely to do so at the 5% significance level, in wave 12, and at the 1% level, in waves 10 and 13, with coefficients of -0.230, -0.278, and -0.302, respectively. Those who have attended college are also more likely to save mainly for the long term, at the 1% significance level in wave 12, at the 5% level in wave 13, and at the 10% level in wave 11, with

coefficients of -0.217, -0.159, and -0.118, respectively. Households who have achieved just A-level education are more likely to save mainly for the long term, at the 10% significance level in wave 10, with a coefficient of -0.149. The scales of these coefficients and their significance levels show that the higher the educational attainment that a household has, the more profound is its long-term saving motive. The hypothesis of time consistency is not rejected, indicating that these effects are stable over the four waves.

The results show that households with higher estimated permanent income are more likely to save mainly for the long term at the 1% significance level in waves 10 and 11, and at the 10% level in waves 12 and 13, with coefficients of -5.76e-06, -5.35e-06, -3.77e-06, and -2.74e-06, consecutively. The scale of the influence decreases continually with time; however, the hypothesis of time consistency is not rejected, showing that these effects are constant over the four waves. This finding suggests that households with higher wealth levels have a weaker precautionary motive.

The previous panel-data estimation showed that households with an employed spouse/partner were more likely to save mainly for the short term at the 1% significance level. The results here show that this correlation is evident at the 5% significance level only in wave 13, with a coefficient of 0.202; positive coefficients are obtained in the other three waves, but they are not statistically evident at the 10% level. The hypothesis of time-consistency is not rejected, showing that this relationship is stable over the four waves. It is considered that having joint income sources would mitigate households' precautionary saving motive, however, the finding here goes against this notion.

The previous panel-data estimation showed that households with few members were more likely to save mainly for the long term at the 10% significance level. The results here show that those with 1-2 members are more likely to save mainly for the long term, at the 10% significance level in wave 10, and those with 3-4 members are more likely to save mainly for the long term, at 10% significance level in wave 13, with coefficients of -0.265 and -0.188 respectively. Most of the insignificant coefficients in other waves have negative signs. This leads to the result that the hypothesis of time consistency is not rejected, showing the effects of household size to be consistent over the four waves.

Where a household is located, to some extent, has an effect on its saving motives. Residents in the West Midlands region are more likely to save mainly for the short term at the 5% significance level in waves 10, 11, and 13, with coefficients of 0.288, 0.320, and 0.345 respectively. This is consistent with the previous panel-data estimations. What is not evident in the previous estimations is as follows: residents in the North West region are more likely to save mainly for the short term at the 5% significance level in wave 11, with a coefficient of 0.310, and residents in Tyne & Wear are more likely to save mainly for the short term, at the 10% significance level, in wave 12, with a coefficient of 0.272. In general, the hypothesis of the time consistency of any residential effect is not rejected, thus showing stability over time.

Table 5.6: SUR model – Whole sample

	Wave 10			Wave 11			Wave 12			Wave 13		
Independent Variables	*Mean*	*Coef.*	*Std Dev.*	*Mean*	*Coef.*	*Std Dev.*	*Mean*	*Coef*	*Std Dev.*	*Mean*	*Coef*	*Std Dev.*
Permanent income	33650.94	-5.74e-06***	1.92e-06	34343.6	-5.35e-06***	1.99e-06	35298.39	-3.77e-06*	1.98e-06	35672.97	-2.74e-06*	1.45e-06
Financial situation												
Good	0.807	-0.190**	0.079	0.847	-0.204**	0.086	0.861	-0.110	0.089	0.881	-0.123	0.093
Bad	0.020	0.095	0.210	0.018	-0.126	0.258	0.015	-0.368	0.237	0.014	0.308	0.282
Financial expectation												
Better-off	0.347	-0.047	0.06	0.327	-0.038	0.061	0.292	-0.002	0.062	0.304	0.082	0.064
Worse-off	0.077	0.076	0.111	0.076	0.042	0.104	0.072	-0.029	0.107	0.068	0.149	0.112
Financial realisation												
Better-off than last year	0.410	-0.034	0.062	0.436	0.069	0.059	0.370	0.006	0.060	0.368	-0.003	0.062
Worse-off than last year	0.152	-0.054	0.083	0.125	-0.082	0.091	0.158	-0.033	0.081	0.134	-0.054	0.091
Pension enrolment	0.281	-0.143**	0.063	0.270	-0.063	0.062	0.279	0.038	0.062	0.252	-0.086	0.065
Homeownership	0.848	-0.191**	0.079	0.859	-0.009	0.084	0.879	-0.173*	0.089	0.868	-0.118	0.084
Female	0.218	0.245***	0.08	0.223	0.378***	0.079	0.209	0.237***	0.084	0.219	0.347***	0.082
Age	42.108	-0.032	0.026	41.992	-0.022	0.024	42.659	-0.034	0.024	43.059	0.022	0.024
Age squared	1871.225	0.0002	0.0003	1862.523	0.0001	0.0003	1923.516	0.0003	0.0003	1959.809	-0.0003	0.0003
Education												
Higher than first degree	0.049	-0.328**	0.138	0.061	-0.361***	0.129	0.064	-0.356***	0.124	0.061	-0.358***	0.131
First degree	0.164	-0.278***	0.093	0.172	-0.119	0.091	0.169	-0.230**	0.091	0.180	-0.302***	0.089
Some college	0.341	-0.097	0.071	0.336	-0.118*	0.071	0.350	-0.217***	0.069	0.343	-0.159**	0.069
A Level	0.121	-0.149*	0.091	0.120	-0.006	0.091	0.117	-0.110	0.097	0.117	-0.021	0.092
Married/Cohabiting	0.747	-0.018	0.104	0.730	0.119	0.104	0.737	-0.033	0.106	0.728	-0.092	0.108
Self-employed	0.113	-0.087	0.109	0.113	0.035	0.106	0.131	-0.143	0.109	0.124	-0.072	0.118
Spouse/partner employed	0.603	0.100	0.083	0.609	0.077	0.081	0.602	0.087	0.083	0.590	0.202**	0.083
Full-time employed	0.928	-0.008	0.116	0.927	0.022	0.112	0.922	0.157	0.109	0.919	-0.007	0.103
Occupation												

Managers & Administrators	0.265	0.352	0.251	0.249	0.168	0.270	0.263	-0.066	0.288	0.264	0.643*	0.363
Professional	0.092	0.262	0.264	0.096	0.273	0.278	0.090	0.059	0.297	0.092	0.673*	0.371
Associate professional & Technical	0.136	0.360	0.256	0.134	0.172	0.274	0.130	0.049	0.293	0.134	0.676*	0.366
Clerical & Secretarial	0.160	0.423*	0.254	0.203	0.205	0.270	0.185	0.027	0.289	0.181	0.797**	0.364
Craft related	0.266	0.578**	0.250	0.240	0.438*	0.269	0.243	0.243	0.287	0.234	0.801**	0.363
Personal & Protective services	0.020	0.735**	0.317	0.023	0.652**	0.324	0.021	0.150	0.331	0.027	0.581	0.398
Sales	0.048	0.667**	0.266	0.046	0.388	0.285	0.058	0.025	0.302	0.059	0.696*	0.380
With children	0.392	0.010	0.089	0.408	0.057	0.089	0.408	0.0003	0.086	0.399	0.088	0.091
Household size												
1-2 members	0.497	-0.265*	0.141	0.493	-0.062	0.134	0.476	-0.053	0.135	0.492	-0.164	0.131
3-4 members	0.427	-0.100	0.111	0.424	-0.096	0.105	0.443	0.031	0.106	0.420	-0.188*	0.100
Region												
Greater London	0.061	-0.000	0.126	0.051	-0.157	0.135	0.050	-0.095	0.149	0.046	-0.115	0.146
South West	0.062	0.001	0.135	0.055	-0.137	0.143	0.054	0.057	0.147	0.049	-0.086	0.159
East	0.085	-0.083	0.122	0.072	0.056	0.129	0.071	0.037	0.124	0.072	-0.059	0.128
West Midlands	0.060	0.288**	0.144	0.049	0.320**	0.150	0.046	0.125	0.147	0.042	0.345**	0.150
Greater Manchester	0.030	0.158	0.171	0.022	-0.066	0.183	0.023	0.094	0.167	0.022	-0.157	0.186
North West	0.044	0.072	0.159	0.042	0.310**	0.154	0.044	-0.008	0.158	0.043	0.013	0.164
Yorkshire & Humberside	0.065	-0.057	0.122	0.053	-0.038	0.135	0.056	-0.108	0.146	0.060	0.093	0.126
Tyne & Wear	0.047	0.179	0.141	0.043	0.174	0.145	0.039	0.272*	0.164	0.036	-0.035	0.164
Wales	0.163	0.050	0.098	0.123	0.074	0.107	0.140	-0.004	0.108	0.148	-0.027	0.105
Scotland	0.230	-0.007	0.091	0.184	-0.051	0.097	0.199	-0.003	0.102	0.191	-0.121	0.100
Northern Ireland	0.009	0.254	0.360	0.182	-0.047	0.101	0.160	-0.088	0.107	0.170	-0.062	0.106

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Table 5.7: Results of test on time-consistency – At the whole sample level

	Whole sample	
Independent variable	***p-value***	***Chi Square statistics***
Permanent income	0.566	2.03
Financial situation		
Good	0.831	0.88
Bad	0.265	3.97
Financial expectation		
Better-off	0.450	2.64
Worse-off	0.710	1.38
Financial realisation		
Better-off than last year	0.668	1.56
Worse-off than last year	0.983	0.16
Pension enrolment	0.225	4.36
Homeownership	0.411	2.88
Female	0.507	2.33
Age	0.335	3.40
Age squared	0.420	2.82
Education		
Higher than first degree	0.998	0.04
First degree	0.492	2.41
Some college	0.631	1.73
A Level	0.635	1.71
Married/Cohabiting	0.538	2.17
Self-employed	0.695	1.45
Spouse/partner employed	0.689	1.47
Full-time employed	0.672	1.55
Occupation		
Managers & Administrators	0.452	2.63
Professional	0.641	1.68
Associate professional & Technical	0.564	2.04
Clerical & Secretarial	0.378	3.09
Craft related	0.651	1.64
Personal & Protective services	0.594	1.90
Sales	0.375	3.11
With children	0.889	0.63
Household size		
1-2 members	0.669	1.56
3-4 members	0.522	2.25
Residential area		
Greater London	0.852	0.79
South West	0.784	1.07
East	0.824	0.90
West Midlands	0.718	1.35
Greater Manchester	0.576	1.98
North West	0.449	2.65
Yorkshire & Humberside	0.734	1.28
Tyne & Wear	0.595	1.89
Wales	0.897	0.60
Scotland	0.821	0.92
Northern Ireland	0.840	0.84

5.4.2 The sub-sample level

The estimated coefficients for homeowners are reported in Table 5.8, and those for private pension participants are reported in Table 5.9. The holding of illiquid wealth and engagement in external saving mechanisms demonstrate that such households manage their self-control problems by means of certain instrumental constraints, in order to meet their optimal saving plans for the long-term perspective. It is thus worthwhile to explore the determinants of the saving motives of these two groups. The results of the hypothesis of time consistency, for both groups, are reported in Table 5.10.

To begin with, households' perceptions of aggregate risk in the short term, i.e. in the next 12 months, do not have an evident impact on determining saving motives. By contrast, private pension participants, who expect to be financially better off and to have lower risk in the short term, are more likely to save mainly for the long term at the 10% significance level in wave 11, with a coefficient of -0.200. This shows that the expectation of a lower aggregate risk in the near future, makes pension participants more inclined to save mainly for the long term and thus averse to saving mainly for the short term; this suggests the possibility that their precautionary motive is weak, in response to a low degree of aggregate future risk. Nevertheless, this finding is only weakly significant, and in addition, worse-off financial expectation, i.e. a higher risk in the short term, does not affect their short-term saving motive. For both groups, the hypotheses of time consistency of effects of these financial expectations are not rejected, showing that the influences of subjective perceptions with short-term risk are consistently insignificant over the four waves.

The status of having a good current financial situation appears to have an influence on both homeowners and private pension participants. Homeowners who are 'living comfortably' or 'doing alright' are more likely to save mainly for the long term at the 5% significance level in wave 10 and at the 10% level in wave 11, with coefficients of -0.216 and -0.175 respectively. Pension participants in a good financial situation are more likely to save mainly for the long term, at the 5% significance level in wave 10, with a coefficient of -0.309. The hypothesis of time consistency is not rejected for both groups, showing that the effect of a good situation is stable over the four waves.

The effect of recent financial experience emerges amongst private pension participants, but not for homeowners. As shown in the results, it is evident that pension participants, who have a better financial situation than last year, are more likely to save mainly for the short term, at the 5% significance level in wave 11, with a coefficient of 0.277; however, this correlation was missing in the previous panel-data estimations. The hypothesis of time consistency is not rejected for homeowners; on the other hand, it is rejected at the 10% significance level for pension participants and this thus points to the observation that the effect of an improving financial experience varies over the four waves.

It is seen that some households own housing wealth and are also paying into a private pension. When considering the sample of homeowners, shares of private pension participants vary from 26.5% to 29.4% over the four waves. By contrast, for private pension participants, the percentages of homeowners range from 88.9% to 92.6%. The results show that homeowners, who have paid into a private pension scheme, are more likely to save mainly for the long term, than those who have not paid into any pension, at the 10% significance level in wave 10, with a coefficient of -0.120. By contrast, the effect of engaging in homeownership emerges as insignificant amongst pension participants. This relationship observed amongst homeowners is only weakly evident. Moreover, for the two groups, the hypothesis of time consistency is not rejected, showing that both the effect of owning a house and the effect of a pension saving commitment are constant over the four waves. These suggest that homeowners' saving motives are not affected by pension enrolment, and pension participants' saving motives are also not influenced by ownership of housing wealth.

For homeowners, the percentages of self-employed households range from 11.4% to 13%, and they vary from 24.7% to 27.3% for private pension participants, over the four waves. For both groups, the results show the status of being self-employed does not have an influence on their saving motives. Moreover, this is considered as consistent over the four waves as the hypothesis of time-consistency is not rejected. The findings for homeowners are consistent with the previous panel-data estimations, whereas the previous estimations showed that self-employed pension participants are more likely to save mainly for the long term at the 10% significance level, which is not evident here.

Homeowners in full-time employment are more likely to save mainly for the short term, at the 10% significance level, only in wave 12, with a coefficient of 0.235. In addition, pension participants in full-time employment are more likely to save mainly for the short term, at the 10% significance level in wave 11, with a coefficient of 0.595. Nevertheless, these results do not show robustness because firstly, they are only weakly significant and secondly, the hypothesis of time consistency is not rejected in both groups, suggesting that the effect of full-time employment is constant over the four waves.

Occupational effects are insignificant for private pension participants, whereas these effects, in some sectors, are observed for homeowners. The results show that homeowners in occupations which feature unstable income streams and high volatility of employment than the 'plant & machine operatives' sector, such as the 'craft related', 'personal & protective services', and 'sales' sectors, are more likely to save mainly for the short term. For the 'sales' sector, the coefficients are 0.588, at the 10% significance level in wave 10, and 1.078, at the 5% level in wave 13; for the 'personal & protective services' sector, the coefficients are 0.801 and 0.836, at the 5% level in waves 10 and 11, respectively, and 1.024, at the 10% level in wave 13; for the 'craft related' sector, the coefficients are 0.593, at the 10% level in wave 10 and 1.127, at the 5% level in wave 13. These results support the possibility that households in these sectors, whilst possessing illiquid wealth, still have a stronger precautionary motive for the short-term future. In wave 13, there is a significant impact in every occupation on homeowners' short term saving motive. Those in the 'managers & administrators', 'professional', 'associate professional & technical', 'associate professional & technical', or 'clerical & secretarial' sectors, are more likely to save mainly for the short term at the 5% or 10% significance levels, with coefficients of 1.020, 1.054, 0.907, and 1.118, respectively. As suggested earlier, this can be attributed to unobserved effects in that wave, and they are particularly influential on homeowners but not pension participants. Despite these fluctuations in the occupational effects, they are consistent over the four waves as the hypothesis of time consistency is not rejected for any sector.

Gender difference has a strong impact on homeowners' saving motives, as results show that female homeowners are more likely to save mainly for the short term, at the 1% significance level in all four waves, with coefficients of 0.347, 0.376, 0.242, and 0.372,

respectively. Amongst private pension participants, females are more likely to save mainly for the short term: this correlation is evident, at the 5% significance level in wave 10, with a coefficient of 0.419, and at the 1% significance level in wave 13, with a coefficient of 0.549. These findings show that even though they possess housing wealth or are saving regularly for retirement, females still show a stronger inclination towards saving for the short-term precautionary purposes as compared with their male equivalents, and moreover, this tendency is more frequently observed amongst homeowners. Moreover, the gender effect is constant over the four waves for both groups.

For both groups, the effects of levels of educational attainment are evident. Amongst homeowners, those with a postgraduate degree are more likely to save mainly for the long term, at the 5% significance level in waves 11 and 12, with coefficients of -0.339 and -0.327, at the 1% level in wave 13, with a coefficient of -0.386, and at the 10% level in wave 10, with a coefficient of -0.263. Those with a first degree are more likely to save mainly for the long term, at the 1% significance level in waves 10 and 13, with coefficients of -0.267 and -0.313, and at the 5% level in wave12, with a coefficient of -0.215. Those who have received a college level of education are more likely to save mainly for the long term, at the 5% significance level in waves 11 and 13, with coefficients of -0.170 and -0.154, and at 1% level in wave 12, with a coefficient of -0.207. Amongst private pension participants, those with a postgraduate degree are more likely to save mainly for the long term, at the 5% significance level in waves 12 and 13, with coefficients of -0.575 and -0.636. Those with a first degree are more likely to do so, at the 5% significance level in wave 10, with a coefficient of -0.408. Those who have had some college education are more likely to save mainly for the long term, at the 1% significance level in wave 12, with a coefficient of -0.565. Comparing the two groups, educational effects are more frequently observed over the four waves, amongst homeowners, and the scales of the effects are larger for pension participants. In general, the hypothesis of time consistency is not rejected for both groups. The exception is found amongst pension participants, in that the hypothesis of time consistency is rejected at the 5% significance level. This is because the influence of having undertaken a college level of education is especially evident in wave 12.

The effects of wealth level, represented by permanent income level, on saving motives are significant amongst homeowners, but not for private pension participants. Homeowners with higher permanent income levels are more likely to save mainly for the long term, at the 1% significance level in waves 10 and 11, at the 10% level in wave 12, and at the 5% level in wave 13, with coefficients of -6.42e-06, -5.87e-06, -3.88e-06, and -3.50e-06, respectively. This suggests the possibility that homeowners with lower wealth levels are more likely to be precautionary with short-term uncertainty and expenses, but pension participants appear to be hardly influenced over the four waves. The hypothesis of time consistency is not rejected for both groups, showing such a pattern is constant over the four waves.

Homeowners with joint income sources are more likely to save mainly for the short term, at the 1% significance level in wave 13, with a coefficient of 0.242, and pension participants with joint income sources are more likely to save mainly for the short term, at the 5% significance level, with a coefficient of 0.411. Comparing the results, the scale of the effect is larger for pension participants than for homeowners. For both groups, although this effect is more profound in wave 13 than in the other waves, it is consistent over the four waves, as the hypothesis of time-consistency is not rejected.

A nonlinear age effect is evident amongst homeowners in wave 12 as a negative coefficient of 'age' is significant, at the 5% significance level and a positive coefficient of 'age^2' is so at the 10% level, with coefficients of -0.064 and 0.001, respectively. This suggests that young and old homeowners are more likely to save mainly for the short term than those in middle-age. By contrast, an age effect is not evident amongst private pension participants. In general, age effects are constant over the waves, for both groups, in that the hypothesis of time consistency is not rejected.

Household size has an impact on homeowners' saving motives, but not on those of private pension participants. Homeowners with 1-2 family members are more likely to save mainly for the long term, at the 5% significance level, in wave 10, with a coefficient of -0.298, than those with 5 or more, and those with 3-4 members are more likely to save mainly for the long term, at the 1% significance level, in wave 13, with a coefficient of -0.274. There is reason to believe that households with more family

members may have a stronger precautionary motive, in that the occurrence of a shock would be more devastating on households with children or elderly dependents, than on those containing only a couple. The hypothesis of time consistency is not rejected for both groups, showing the effect of household size is constant over the four waves.

Homeowners in the West Midlands are more likely to save mainly for the short term, at the 10% significance level, in wave 10, and, at the 5% level, in waves 11 and 13, with coefficients of 0.258, 0.328, and 0.397, respectively. Of all the residential areas, this regional effect, i.e. living in the West Midlands, is the most frequently observed in the four waves. Those living in the Greater London area are more likely to save mainly for the long term, at the 10% level, with a coefficient of -0.254. On the other hand, these regional effects are not evident for private pension participants.

Homeowners in the North West region are more likely to save mainly for the short term at the 10% significance level in wave 11, with a coefficient of 0.279; private pension participants in this region are more likely to do so, at the 10% significance level in waves 11 and 12, with coefficients of 0.532 and 0.529. Homeowners living in Tyne & Wear are more likely to save mainly for the short term, at the 10% significance level in wave 12, with a coefficient of 0.315. Pension participants who live in this region are more likely to save for the short term in waves 11 and 12, with coefficients of 0.487 and 0.525. It can be seen that these two regional effects are more frequently observed and of greater magnitude for pension participants than for homeowners.

Some regional effects are only evident for pension participants. They are as follows: those living in the Greater Manchester are more likely to save mainly for the long term, at the 1% significance level in wave 13, with a coefficient of -1.091; those living in Scotland are more likely to save mainly for the short term, at the 10% significance level, with a coefficient of 0.319.

For homeowners, each regional effect is consistent over the four waves in that no hypothesis of time consistency is rejected. On other hand, for pension participants, one exception occurs in the case of residents in Greater Manchester; the hypothesis of time consistency is rejected at the 5% significance level, and this shows that such an effect is not consistent over time, and confirms that this regional effect in wave 13 is distinct.

Table 5.8: SUR model - Homeowners

	Wave 10			Wave 11			Wave 12			Wave 13		
Independent Variables	*Mean*	*Coef.*	*Std Dev.*	*Mean*	*Coef.*	*Std Dev.*	*Mean*	*Coef*	*Std Dev.*	*Mean*	*Coef*	*Std Dev.*
Permanent income	35600.93	-6.42e-06***	2.05e-06	36145.65	-5.87e-06***	2.14e-06	36939.65	-3.88e-06*	2.05e-06	37355.59	-3.50e-06**	1.53e-06
Financial situation												
Good	0.821	-0.216**	0.088	0.861	-0.175*	0.098	0.873	-0.092	0.099	0.897	-0.157	0.108
Bad	0.016	-0.162	0.250	0.017	-0.142	0.293	0.013	-0.239	0.275	0.012	0.168	0.326
Financial expectation												
Better-off	0.348	-0.044	0.066	0.314	-0.019	0.066	0.284	-0.013	0.066	0.289	0.111	0.069
Worse-off	0.082	0.059	0.117	0.080	0.019	0.110	0.078	-0.033	0.110	0.065	0.169	0.121
Financial realisation												
Better-off than last year	0.397	-0.036	0.066	0.423	0.084	0.063	0.364	-0.029	0.065	0.360	0.004	0.067
Worse-off than last year	0.151	-0.058	0.091	0.133	-0.025	0.097	0.163	-0.046	0.086	0.133	-0.019	0.098
Pension enrolment	0.294	-0.120*	0.068	0.283	-0.067	0.066	0.294	0.023	0.065	0.265	-0.037	0.068
Homeownership	--	--	--	--	--	--	--	--	--	--	--	--
Female	0.188	0.347***	0.094	0.190	0.376***	0.091	0.184	0.242***	0.094	0.196	0.372***	0.091
Age	42.487	-0.036	0.029	42.376	-0.039	0.026	43.026	-0.064**	0.026	43.574	0.026	0.027
Age squared	1899.979	0.0003	0.0003	1890.456	0.0003	0.0003	1951.305	0.001*	0.0003	1999.512	-0.0004	0.0003
Education												
Higher than first degree	0.053	-0.263*	0.149	0.065	-0.339**	0.135	0.066	-0.327**	0.131	0.060	-0.386***	0.139
First degree	0.172	-0.267***	0.102	0.181	-0.127	0.097	0.177	-0.215**	0.097	0.183	-0.313***	0.095
Some college	0.353	-0.068	0.079	0.338	-0.170**	0.077	0.360	-0.207***	0.075	0.349	-0.154**	0.076
A Level	0.127	-0.126	0.099	0.122	-0.043	0.098	0.119	-0.099	0.103	0.122	-0.019	0.099
Married/Cohabiting	0.782	0.020	0.116	0.771	0.099	0.115	0.767	0.017	0.115	0.761	-0.103	0.118
Self-employed	0.115	-0.079	0.118	0.114	0.082	0.112	0.130	-0.093	0.117	0.125	-0.127	0.126
Spouse/partner employed	0.635	0.112	0.088	0.646	0.097	0.086	0.623	0.075	0.087	0.619	0.242***	0.088
Full-time employed	0.938	0.111	0.135	0.944	0.109	0.137	0.931	0.235*	0.125	0.927	-0.037	0.113
Occupation												
Managers & Administrators	0.284	0.367	0.328	0.267	0.217	0.328	0.281	-0.190	0.364	0.278	1.020**	0.513
Professional	0.097	0.246	0.339	0.097	0.351	0.336	0.095	-0.053	0.372	0.091	1.054**	0.521

Associate professional & Technical	0.127	0.304	0.333	0.128	0.200	0.333	0.126	-0.074	0.369	0.132	0.997*	0.515
Clerical & Secretarial	0.164	0.428	0.331	0.208	0.267	0.328	0.189	-0.058	0.365	0.187	1.118**	0.513
Craft related	0.258	0.593*	0.328	0.233	0.484	0.327	0.232	0.115	0.365	0.228	1.127**	0.512
Personal & Protective services	0.013	0.801**	0.392	0.015	0.836**	0.407	0.015	-0.064	0.419	0.019	1.024*	0.559
Sales	0.046	0.588*	0.343	0.045	0.437	0.345	0.054	-0.151	0.378	0.057	1.078**	0.534
With children	0.399	0.024	0.097	0.419	0.065	0.096	0.415	-0.041	0.094	0.410	0.116	0.098
Household size												
1-2 members	0.479	-0.298**	0.150	0.476	-0.110	0.143	0.462	-0.130	0.144	0.473	-0.197	0.140
3-4 members	0.440	-0.130	0.116	0.438	-0.091	0.112	0.454	-0.002	0.111	0.436	-0.274***	0.106
Region												
Greater London	0.055	-0.145	0.144	0.045	-0.254*	0.153	0.047	-.058	0.159	0.041	-0.046	0.160
South West	0.058	0.036	0.143	0.051	-0.120	0.159	0.053	0.101	0.158	0.051	-0.018	0.168
East	0.082	-0.176	0.132	0.069	0.019	0.140	0.069	0.023	0.131	0.070	-0.123	0.140
West Midlands	0.062	0.258*	0.152	0.050	0.328**	0.158	0.047	0.154	0.153	0.043	0.397**	0.163
Greater Manchester	0.030	-0.053	0.184	0.023	-0.095	0.194	0.023	0.109	0.177	0.024	-0.185	0.193
North West	0.046	-0.042	0.169	0.043	0.279*	0.164	0.046	-0.020	0.165	0.046	0.021	0.173
Yorkshire & Humberside	0.066	-0.112	0.137	0.054	-0.009	0.147	0.057	-0.222	0.158	0.060	0.127	0.137
Tyne & Wear	0.046	0.040	0.155	0.043	0.191	0.160	0.040	0.315*	0.175	0.037	-0.080	0.175
Wales	0.174	-0.032	0.106	0.130	0.061	0.116	0.145	-0.004	0.115	0.145	-0.041	0.115
Scotland	0.229	-0.034	0.099	0.178	-0.088	0.107	0.189	-0.025	0.109	0.190	-0.126	0.111
Northern Ireland	0.010	0.331	0.361	0.193	-0.081	0.109	0.161	-0.140	0.114	0.177	-0.090	0.115

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Table 5.9: SUR model - Private pension participants

	Wave 10			Wave 11			Wave 12			Wave 13		
Independent Variables	*Mean*	*Coef.*	*Std Dev.*	*Mean*	*Coef.*	*Std Dev.*	*Mean*	*Coef*	*Std Dev.*	*Mean*	*Coef*	*Std Dev.*
Permanent income	35115.630	-4.55e-06	2.91e-06	36461.810	-4.49e-06	3.24e-06	37049.490	-3.71e-06	3.27e-06	39946.150	-3.13e-06	2.12e-06
Financial situation												
Good	0.815	-0.309**	0.156	0.889	-0.016	0.197	0.869	-0.222	0.176	0.897	-0.239	0.224
Bad	0.011	-0.183	0.637	0.017	-0.484	0.539	0.013	-0.293	0.578	0.017	-0.162	0.520
Financial expectation												
Better-off	0.335	0.013	0.115	0.325	-0.200*	0.121	0.299	-0.100	0.125	0.294	0.150	0.138
Worse-off	0.076	0.283	0.229	0.080	0.027	0.206	0.057	-0.172	0.224	0.061	0.136	0.235
Financial realisation												
Better-off than last year	0.417	-0.082	0.117	0.445	0.277**	0.122	0.347	-0.072	0.121	0.338	0.166	0.129
Worse-off than last year	0.141	-0.065	0.179	0.137	0.040	0.175	0.172	0.060	0.164	0.157	0.080	0.180
Pension enrolment	--	--	--	--	--		--	--	--	--	--	--
Homeownership	0.889	0.041	0.176	0.902	-0.019	0.202	0.926	-0.251	0.211	0.916	0.254	0.224
Female	0.154	0.419**	0.175	0.141	0.235	0.162	0.118	0.032	0.193	0.128	0.549***	0.210
Age	42.335	-0.028	0.049	42.672	-0.068	0.055	43.306	-0.049	0.048	44.229	-0.037	0.057
Age squared	1889.550	0.0002	0.001	1910.482	0.001	0.001	1978.675	0.0003	0.001	2055.797	0.0003	0.001
Education												
Higher than first degree	0.041	-0.377	0.297	0.050	-0.362	0.309	0.042	-0.575**	0.257	0.063	-0.636**	0.275
First degree	0.176	-0.408**	0.179	0.180	-0.234	0.179	0.179	-0.205	0.171	0.182	-0.103	0.188
Some college	0.365	-0.128	0.134	0.353	-0.032	0.141	0.356	-0.565***	0.133	0.358	-0.158	0.146
A Level	0.102	-0.033	0.181	0.121	0.133	0.178	0.118	-0.219	0.190	0.105	0.088	0.204
Married/Cohabiting	0.780	0.006	0.210	0.781	0.226	0.205	0.810	-0.074	0.212	0.778	-0.218	0.233
Self-employed	0.250	-0.175	0.158	0.247	0.056	0.160	0.262	-0.191	0.153	0.273	-0.230	0.176
Spouse/partner employed	0.648	0.029	0.168	0.642	0.136	0.153	0.635	0.127	0.149	0.623	0.411**	0.173
Full-time employed	0.954	0.269	0.270	0.967	0.595*	0.371	0.948	0.219	0.259	0.956	-0.284	0.271
Occupation												
Managers & Administrators	0.298	0.095	0.318	0.299	-0.028	0.464	0.343	0.096	0.441	0.331	0.454	0.530
Professional	0.106	0.309	0.365	0.128	0.357	0.475	0.094	0.515	0.467	0.105	0.668	0.550

Associate professional & Technical	0.069	-0.037	0.359	0.065	-0.086	0.499	0.066	0.011	0.494	0.075	0.740	0.560
Clerical & Secretarial	0.154	-0.051	0.334	0.184	0.087	0.475	0.142	0.238	0.454	0.151	0.385	0.542
Craft related	0.244	0.315	0.327	0.213	0.189	0.473	0.229	0.405	0.456	0.208	0.533	0.537
Personal & Protective services	0.011	0.619	0.664	0.011	0.230	0.766	0.013	0.864	0.641	0.013	0.451	0.722
Sales	0.087	0.314	0.341	0.078	0.342	0.496	0.094	0.258	0.466	0.103	0.745	0.539
With children	0.387	-0.067	0.175	0.410	0.190	0.197	0.426	-0.232	0.178	0.419	-0.234	0.212
Household size												
1-2 members	0.461	-0.409	0.269	0.477	-0.101	0.262	0.423	-0.167	0.257	0.459	-0.386	0.278
3-4 members	0.461	-0.141	0.211	0.423	-0.019	0.190	0.476	0.108	0.186	0.436	-0.090	0.197
Region												
Greater London	0.063	0.151	0.240	0.045	0.227	0.262	0.037	-0.279	0.315	0.040	-0.210	0.339
South West	0.080	0.060	0.239	0.065	0.100	0.249	0.061	-0.177	0.282	0.050	0.231	0.295
East	0.096	0.104	0.219	0.089	-0.082	0.208	0.089	0.189	0.215	0.109	-0.244	0.232
West Midlands	0.085	0.133	0.243	0.063	0.415	0.263	0.054	0.299	0.268	0.050	0.342	0.334
Greater Manchester	0.020	-0.219	0.377	0.015	0.323	0.444	0.026	0.209	0.321	0.021	-1.091***	0.393
North West	0.044	0.137	0.314	0.039	0.532*	0.302	0.042	0.529*	0.273	0.036	0.375	0.356
Yorkshire & Humberside	0.076	-0.187	0.231	0.058	0.282	0.249	0.050	-0.170	0.281	0.065	-0.039	0.227
Tyne & Wear	0.044	0.022	0.293	0.041	0.487*	0.284	0.046	0.525*	0.304	0.023	0.008	0.444
Wales	0.152	-0.035	0.192	0.124	0.136	0.203	0.144	-0.092	0.207	0.134	0.013	0.219
Scotland	0.170	0.064	0.190	0.139	0.319*	0.190	0.159	0.073	0.198	0.170	-0.268	0.214
Northern Ireland	0.009	-0.092	0.663	0.186	0.119	0.199	0.142	-0.099	0.200	0.170	-0.133	0.219

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Table 5.10: Results of test on time-consistency – At the subgroup level

	Homeowners		Private pension participants	
Independent variable	p-value	*Chi Square statistics*	p-value	*Chi Square statistics*
Permanent income	0.619	1.78	0.976	0.21
Financial situation				
Good	0.825	0.90	0.705	1.40
Bad	0.801	1.00	0.975	0.22
Financial expectation				
Better-off	0.376	3.10	0.253	4.08
Worse-off	0.655	1.62	0.543	2.15
Financial realisation				
Better-off than last year	0.526	2.23	0.089*	6.51
Worse-off than last year	0.991	0.11	0.941	0.39
Pension enrolment	0.493	2.40	--	--
Homeownership	--	--	0.429	2.76
Female	0.713	1.37	0.267	3.95
Age	0.116	5.91	0.955	0.33
Age squared	0.154	5.26	0.955	0.33
Education				
Higher than first degree	0.946	0.37	0.873	0.70
First degree	0.563	2.05	0.693	1.45
Some college	0.629	1.74	0.028**	9.10
A Level	0.864	0.74	0.549	2.11
Married/Cohabiting	0.678	1.52	0.528	2.22
Self-employed	0.583	1.95	0.591	1.91
Spouse/partner employed	0.529	2.22	0.428	2.77
Full-time employed	0.450	2.64	0.234	4.27
Occupation				
Managers & Administrators	0.278	3.85	0.917	0.51
Professional	0.385	3.04	0.950	0.35
Associate professional & Technical	0.406	2.91	0.654	1.62
Clerical & Secretarial	0.308	3.60	0.903	0.57
Craft related	0.442	2.69	0.968	0.26
Personal & Protective services	0.299	3.68	0.932	0.44
Sales	0.257	4.05	0.903	0.57
With children	0.698	1.43	0.372	3.13
Household size				
1-2 members	0.803	0.99	0.798	1.01
3-4 members	0.349	3.29	0.819	0.93
Residential area				
Greater London	0.768	1.14	0.517	2.28
South West	0.790	1.04	0.786	1.06
East	0.639	1.69	0.522	2.25
West Midlands	0.729	1.30	0.880	0.67
Greater Manchester	0.718	1.35	0.043**	8.13
North West	0.490	2.42	0.774	1.11
Yorkshire & Humberside	0.376	3.10	0.516	2.28
Tyne & Wear	0.390	3.01	0.509	2.32
Wales	0.923	0.48	0.876	0.69
Scotland	0.901	0.58	0.241	4.20
Northern Ireland	0.668	1.56	0.823	0.91

5.4.3 Summary

At the whole sample level, the key findings are as follows. Households that possess illiquid assets are more likely to save mainly for the long term and thus less likely to save mainly for the short term. This provides evidence for the quasi-hyperbolic consumption model. Financial expectations, the proxy indicator for short-term aggregate risk, do not impact upon the short-term saving motive, and this shows that households do not have stronger short-term saving motives when they are faced with a risk of financial shock. Thus this does not support the buffer-stock model. Gender difference has a strong effect on short-term saving motives, indicating that females appear to have stronger short-term precautionary saving motives than males. This can be explained by that, in a household, it is mainly the female(s) who are in charge of financial management over a short-term time horizon, and this pattern is enhanced when they play the role as the heads of a household. A long-term saving motive is found to be more profound amongst households with high educational attainment. Households in occupations with volatile income streams are inclined towards saving mainly for the short term.

The comparison of the estimation results of the two samples has shown a difference in the determinants of the saving motives of homeowners and private pension participants. To sum up, a significant relationship between good current financial situation and long-term saving motive is observed amongst both homeowners and private pension participants, and this confirms the enhancing influence that a good current financial status has on the long-term saving motive. It is evident in both samples that females still have an inclination to save for the short term, even though they own housing wealth or have committed themselves to schemes for long-term savings.

Amongst private pension participants, a positive relationship between long-term saving and better-off financial expectation is observed; this suggests that those with less short-term aggregate uncertainty are more likely to save mainly for the long term and less likely to save for the short term. However, this is not a robust finding and cannot support the precautionary saving behaviour concept.

Some factors are influential for homeowners but not for private pension participants, such as: occupational type, age, estimated permanent income, and household size. The effect of pension enrolment is weakly significant on the homeowners' long-term saving motive; conversely, homeownership does not make any difference to pension participants' saving motives across the four waves.

Whilst the previous panel-data estimations obtained a stable effect for a given variable on saving motives, the estimations of a SUR model show the changes of the effect over time for a given variable, allowing for time consistency to be examined. In this study, the hypothesis of time consistency is not rejected either at the whole sample level or in the subgroup of homeowners.

By contrast, the occurrence of time inconsistency is observed in the subgroup of private pension participants. For this group, these effects are not constant over the four waves for the following variables: an improving recent financial experience, college level educational attainment, and residents of Greater Manchester, at the 10%, 5%, and 5% significance levels, respectively. The previous estimated results of a random-effect Probit model shown in indicate a negative coefficient of the college level educational attainment at the 1% significance level, and in addition, the results in Table 5.9 indicated that the coefficients of this variable over the four waves were simultaneously of a negative sign, though not necessarily statistically significant. This confirms that the influence of this educational level is not ambiguous. By contrast, concerning the rejection in the cases of an improving recent financial experience and of living in Greater Manchester, this researcher would propose that the significant results in a specific wave may relate simply to a chance. The explanations of this are as follows. Firstly, the results in Table 5.5 showed that the coefficients of these two factors were not significant at the 10% significance level, with one positive coefficient and one negative, respectively. Secondly, regarding the 'improving financial experience', as shown in Table 5.9, the coefficients were negative in sign in waves 10 and 12, and positive in waves 11 and 13. Regarding the effect of living in Greater Manchester, the coefficients were in negative in sign only in waves 10 and 13, and positive in waves 11 and 12. This suggests inconsistency in the influences of these factors over time.

5.5 CONCLUSION

At the whole sample level, precautionary saving behaviour, from a short-term perspective[91], is not evident in that financial expectations have no significant influence on a change in saving motives. Moreover, many of the findings do not support the possibility of such precautionary saving behaviour. Compared with employees, the self-employed do not show any inclination to save mainly for the short term, and this is opposite to the notion that being more financially vulnerable, they may save more for the short term. This can be explained in that the self-employed, as entrepreneurs, have a stronger motive for saving than employees, and are always prepared for liquidity needs in the short term; on the other hand, as individuals, they are more concerned with life after retirement than employees, because their social security welfare benefits are less guaranteed. This study found that households with joint income sources are more likely to save mainly for the short term; this suggests that these households are more concerned with things they need now, or secondly that they are more likely to engage themselves in precautionary saving. The second inference is opposite to the prediction in the buffer stock model, and the first inference emerges possibly because their spouses/partners work as a result of that these households are in need of more income. Age effects do not emerge as evident, in that young households are not found to have a stronger short-term saving motive, as they are easily confronted with liquidity constraints. One exception is that households in occupations with high income variability as well as unstable income flow, i.e. the craft related, the personal & protective services, and the sales sectors, show an inclination to save mainly for the short term, no matter whether they are employees or self-employed. For the subgroups - homeowners and private pension participants, precautionary saving behaviour, from a short-term perspective, is also not evident. The occupational effects are apparent only for homeowners.

A key finding, at the whole sample level, supports the quasi-hyperbolic consumption model: homeowners, who are characterised as holding illiquid wealth, are also inclined towards saving mainly for the long term and averse to saving mainly for the short term,

[91] Whilst some literature suggested that households may accumulate (illiquid) wealth to buffer the risk in the long term future (Laibson, 1997; Carroll and Samwick, 1998; Carroll, Dynan, and Krane, 2003), this study is not able to directly examine such precautionary saving behaviour from a long-term perspective, yet will leave this issue for future investigation.

when they make discretionary savings. By contrast, private pension participants, who are seen as committing themselves to external saving mechanisms to save for retirement, do not show evidently different saving preferences to non-pension participants. However, at the subgroup level, private pension enrolment does not show any further impact on those who also hold housing wealth, and homeownership is not influential on those who have paid into a private pension scheme.

At the whole sample level and subgroup level, females have a stronger short-term saving motive than males. Moreover, having undertaken higher education has an enhancing effect on households' inclination to save mainly for the long term.

Two estimation approaches have been employed: one is a random-effect ordered Probit model on an unbalanced panel dataset, and the other is a SUR model on four cross-sectional datasets. Whilst simple cross-sectional estimation is not able to distinguish some unspecified effect over several time periods, a SUR model partially solves this problem by assuming the four cross-sectional waves are correlated in a single system. Moreover, the time consistency of the coefficients of a given independent variable over the four waves can be examined, as these coefficients exhibit fluctuations over time. The results show that, at the whole sample level, the estimated coefficients of each independent variable, in a SUR model, are consistent over the four time periods, and this is also the case for homeowners. However, inconsistency occurs amongst the pension participants on the effects of: having a better-off recent financial experience, having attained a college level of education, and living in the Greater Manchester area. The effect of having attained a college level of education was only evident in a specific wave (wave 12). However, the significant influences of the other two factors of the three mentioned above were possibly the results of chance.

CHAPTER 6 : SAVING RATIOS, RISK, AND SELF-CONTROL PROBLEMS

6.1 INTRODUCTION

In chapter 5, the determinants of households' saving motives were explored. Being a sequential study to chapter 5, this chapter investigates determinants of households' saving ratios from a long-term and from a short-term perspective, respectively. The short-term saving ratio of each household is measured as imputed short-term savings to permanent income ratio, and long-term saving ratio as imputed long-term savings to permanent income ratio. The method of measuring a household's long-term savings and short-term savings has been illustrated in chapter 3. Therefore, the research hypotheses addressed in chapter 5 will be examined in this chapter.

Short-term savings represent household's realised saving acts from a short planning horizon and long-term savings for a long planning horizon. As Lusardi (1998) suggested, the length of a planning horizon of a financial decision is a result of a consumer's time preference. The quasi-hyperbolic consumption model posits that a saving decision of a long planning horizon points towards a low intertemporal time preference, because a household act rationally with saving for the long term. By contrast, a short planning horizon indicates a high time preference as a household may act in the opposite fashion to how it should have acted, owing to its bias towards instant spending.

In this chapter, a new explanatory variable is included, in order to take into account the effect of habit in households' saving ratios. In the BHPS, an individual was asked about his/her first reason for saving, and some of them answered 'no specific reason'; in this case, it seems appropriate to see this as a well-established saving habit. In psychology, habit implies a tendency towards repetitive and routine behaviour. For instance, Katona (1975, 1980) posited that most human behaviour was routine behaviour. Such an effect persists because breaking a well-established habit usually involves pain as human nature appears to be resistant to changes, i.e. the endowment effect. The savings 'for no specific reason' exist as a consequence of controlling consumption expenditure below a

certain level. The control may be primary goal and the saving serves as the outcome, or the saving may be the primary goal and the control of expenditure serves as the means (Wärneryd, 1999). In terms of the behavioural life-cycle model (BLC) (Shefrin and Thaler, 1988), continued saving habits of using rules can be a practice of households' internally precommitting themselves to save, in order to meet the long-term goal of utility maximisation.

A random-effect Tobit regression model is chosen as the estimation approach. The choice of a Tobit regression is dependent on the censoring feature of the saving ratio as some observations registered a value at '0'. Censoring occurred as the consequence of the method that was applied to impute household's long-term savings and short-term savings. Estimation will be applied on the whole sample and two subgroups – homeowners and private pension participants.

Section 6.2 reviews the empirical framework of this work. Section 6.3 contains the analyses on the estimated coefficients and marginal effects at the whole sample level. Section 6.4 carries out similar analyses by contrasting subgroups: private pension participants vs. homeowners. The conclusions are addressed in section 6.5.

6.2 REVIEW OF METHODOLOGY

The estimation equation under a random-effect Tobit model is presented as,

$$\frac{S_{it}}{Y_{it}^{p}}^{*} = \alpha_0 + \alpha_1 Y_{it}^{p} + \alpha_2 F_{it}^{e} + X_{it}'\beta + \varsigma_t'\gamma + v_i + e_{it}, \quad e_{it} \sim IID(0,\sigma_e^2) \quad v_i \sim IID(0,\sigma_v^2),$$

where i denotes each household, and t denotes each waves of waves 10~13.

$\frac{S_{it}}{Y_{it}^{p}}^{*}$ is a latent variable and denotes either the observed short-term saving ratio or the observed long-term saving ratio of each household for a given wave. Note that households' observed saving ratios are measured according to a weighting standard, and this has been addressed in chapter 3.

$$\frac{S_{it}}{Y_{it}^{p}} = 0 \quad \text{if} \quad \frac{S_{it}}{Y_{it}^{p}}^{*} \leq 0$$

$$\frac{S_{it}}{Y_{it}^{p}} = \frac{S_{it}^{*}}{Y_{it}^{p}} \quad \text{if} \quad \frac{S_{it}^{*}}{Y_{it}^{p}} > 0$$

Y_{it}^{p} represents the estimated permanent income of each household at a given time, and serves as a proxy for the household wealth level. F_{it}^{e} denotes each household's subjective evaluation of its aggregate risk in the next 12 months, reflecting the expectation regarding the general economic situation, including inflation and unemployment, as well as the expectation of their financial status. X_{it} denotes a vector of control variables, such as the household's current financial situation, financial realisation compared to one year ago, age, age squared, education dummies, region dummies, the household size, with/without children, marital status, self-employed/employee, owning housing wealth, paying into a private pension, saving for any specific reason or not, and fulltime/part-time employment. ς_{it} denotes the year dummies. v_i denotes the unobserved household effects and is assumed to be randomly distributed and independent of the independent variables and the rest of the error term. e_{it} is the idiosyncratic error term. The estimated coefficients are taken as the value of the maximum of a log-likelihood function.

The reported coefficients of the Tobit model represents, if statistically significant, are only a latent scale and the direction of influences. The impacts of a given independent variable on saving ratio comprise two factors: one is on the possibility that households have a positive saving ratio and the other is on the change in saving ratio, provided that the households have already been making savings (McDonald and Moffitt, 1980). Accordingly, the relative magnitudes of two sub-effects can be measured as follows: one is the change in saving ratio conditional upon their being positive, weighted by the probability of being above the limit, and the other is the change in the probability of their being a positive saving ratio weighted by the expected mean saving ratio conditional on their being positive. This can be illustrated in the equation below[92],

$$\frac{\partial E(y_{it} \mid x_{it})}{\partial x_{it}} = \Pr ob[y_{it} > 0] \frac{\partial E[y_{it} \mid x_{it}, y_{it} > 0]}{\partial x_{it}} + E[y_{it} \mid x_{it}, y_{it} > 0] \frac{\partial \Pr ob[y_{it} > 0]}{\partial x_{it}}$$

[92] This equation confirms that a change in x_i has two effects: it affects the conditional mean of y_i^* in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. The relative magnitudes of these two quantities are an important indicator with economic implication. (McDonald and Moffitt, 1980)

When the two marginal sub-effects (elasticity) of each independent variable are reported, the relative magnitudes will be exhibited only upon the condition that the estimated marginal effects are significant at the 10% significance level.

6.3 EMPIRICAL ANALYSIS AND RESULTS – AT THE WHOLE SAMPLE LEVEL

Table 6.2 reports the estimated coefficients at the whole sample level. The bottom of the table shows the numbers of censored and uncensored observations. The rho (ρ) value indicates the percentage of the measurement error that is captured by the random-effect error term, which denotes the time-invariant unobserved household heterogeneity. It is 0.4 in the case of the short-term saving ratio and 0.488 in the case of the long-term saving ratio; they are considerably high values, and confirm the efficacy of applying a random-effect estimation approach.

Two types of estimated marginal effects are shown in Table 6.3: effects on the change in possibility of households having positive savings and effects on changes in saving ratio provided that households have already been saving. At the bottom of Table 6.3, the estimated probability of households having savings and estimated mean of saving ratio, conditional upon positive observations, are reported respectively, for the cases of the short-term saving and the long-term saving ratios. Accordingly, Table 6.4 exhibits, for the total marginal effects, the relative magnitudes of the two effects, if they previously emerged as statistically significant at the 10% significance level.

6.3.1 Short-term saving ratio

The estimated coefficients of a better-off financial expectation and of a worse-off financial expectation are -0.001 and 0.004. This shows that households who expect less short-term uncertainty could save less for the short term and those who expect higher uncertainty could tend to save more. However, owing to the two coefficients being statistically insignificant at the 10% significance level, the association between household's subjectively-perceived risk and its short-term saving ratio does not hold.

By contrast, Guariglia (2001), who used datasets of wave 6~8 in the BHPS, found that households who expected their financial situation to be worse-off saved more. This disparity can be attributed to two features of the study. One is that, in Guariglia (2001), savings only considered mixed amounts for long-term purposes and those for short-term/precautionary motives, ignoring heterogeneity arising from saving decisions for different planning horizons, i.e. time preference. The other point comes from the time period when the survey was carried out, considering years prior to those of this study, and bias may have arisen if British households' behaviours have been changing considerably[93].

The estimated results show that current financial situations are not associated with short-term saving ratios, whereas a better-off financial situation, in comparison with the previous year, is. Households that perceive themselves to be financially better off than last year, tend to save more for the short term at the 1% significance level; on the other hand, those perceiving themselves to be worse off financially than last year, do not show evident change in the variation in short-term saving ratio at the 10% significant level. Table 6.3 shows that the estimated marginal effects of better-off financial realisation are strongly significant, not only on the increase in probability of households having positive short-term saving ratio, but also on the increase in households' short-term saving ratio, if they have already been making saving. Table 6.4 confirms the relative magnitudes of the two effects: the former takes up 77.83% and the latter 22.17%. The magnitudes of the latter effect – 22.17% - is obtain by: $\frac{0.002*(4787/7197)}{0.006}*100\%$, where 0.002 is the estimated marginal effect on the increase in households' short-term saving ratio; the ratio of $4787/7197$ is the probability that an observation is uncensored, namely, the ratio of uncensored observations to total observations; 0.006 is the aggregate marginal effect, i.e. the estimated coefficient (slope). Therefore, the magnitude of the former effect is 77.83% $(1-22.17\%)$.

[93] Long-term savings ratio is not associated with financial expectations either, which will be mentioned later.

A well-established habit can have an impact on a household's saving behaviour, and this is especially so in the domain of Behavioural Economics (Katona, 1980). A continued habit suggests an endowment effect, which features as resistance to changes in human nature. As discussed previously, the formation of saving habits takes place so as to control consumption expenditure below a certain level (Wärneryd, 1999). Moreover, it plays the role as a rule of thumb of precommitments (Shefrin and Thaler, 1988). Being aware of the difficulties in capturing such effect with a single proxy indicator, 'saving for no specific reason[94]' was chosen for this study from a list of first reasons for saving surveyed for each individual as the habit effect[95] (Wärneryd, 1999). Table 6.1 gives the cross-tabulated results of the percentages of mainly habit-driven observations, by saving motives. It is seen that the percentage of observations that save for no specific reason is the lowest (33.9%) amongst the groups who save mainly for the short term, whereas the percentage of those who save mainly for the long term (46.5%) is close to that of those who save for both equally (46.6%). These results indicate the possibility that households engaging in long-term savings are more likely to save due to a habit effect in the first place.

Table 6.1: Percentages of first reason for saving - no specific reason and with specific reason - by three saving motives

First reason for saving / Saving motive	No specific reason	Percentage	With specific reasons	Percentage	Total Obs.
Mainly short term	742	33.9%	1445	66.1%	2187
Both equally	891	46.6%	1020	53.4%	1911
Mainly long term	1442	46.5%	1657	53.5%	3099
Total observations	3075	42.7%	4122	57.3%	7197

The estimated results here show that a significant association between the habit indicator and short-term saving ratio emerges. Households who make savings on the basis of a habit in the first place, tend to save less for the short term at the 1% significance level, with a coefficient of -0.018. Estimated marginal effects of habit appear strongly evident both on the decrease in possibility of households having a short-

[94] Savers were also asked about their first reason for saving, and the reasons covered 'holidays', 'old age', 'car', 'children', 'house purchases', 'home improvement', 'household bills', 'special events', 'no specific reason', 'share schemes', 'own education', 'grandchild', and 'other'. Saving for no specific reason may pick up idea of saving for peace of mind (Horika and Watanabe, 1997) or saving for "saving per se", which can arguably emerge as a form of habit.

[95] Guariglia (2001) considered savings for no specific reason to be precautionary savings.

term saving ratio and on the decrease in short-term saving ratio if these households have already been making saving. Table 6.4 confirms that, of the total marginal effect, the former effect takes up 74.13% and the latter 25.87%. The results mentioned above suggest that households, who practice a routine to control consumption expenditure, save less and are less likely to save mainly for the short term[96]. This can be explained by the quasi-hyperbolic consumption model, in that these households are largely impatient with short-term saving and prefer instant gratification, if they do not have particular goals to meet. Moreover, mental accounting offers an explanation: in the short-term, savings for specific purposes are allocated into accounts with a lower propensity to consume, whereas savings as a result of routine, in particular as they serve as secondary outcome of controlling expenditure, are placed in an account with higher propensity to consume. And this leads to a lower short-term saving ratio.

Homeownership operates as a proxy for possession of illiquid wealth. The estimates show that homeowners tend to save less for the short term than non-homeowners, at the 1% significance level, with a coefficient of -0.009. Estimates of the marginal effects shown in Table 6.3, confirm that homeowners not only are disinclined to save for the short term, with an estimate of -0.044, but also save less if they have already been saving, with an estimate of -0.004. Table 6.4 exhibits the relative magnitudes with 70.44% for the former effect and 29.56% for the latter. On the other hand, the effect of paying into private pension schemes is not statistically significant on a household's short-term saving ratio.

In general, homeowners are usually less liquidity-constrained than their counterparts in the sense that housing wealth can generate collateralised liquidity when needed; thus, housing wealth can serve as savings to defend against negative financial shocks. Carroll, Dynan, and Krane (2003)[97] suggested that households with a hyperbolic discount function tend to accumulate illiquid assets, such as housing wealth, to buffer income risk in the long run. However, this does not explain why households' engagement in housing wealth lowers their holdings of *'short-term'* discretionary savings. Because

[96] Results also show that savers who are driven mainly by habit effect have indifferent long-term savings ratio from those who are motivated by specific purposes of savings.
[97] Carroll, Dynan and Krane (2003) not only provided a empirical finding that broke through presumed theoretical association between income risk and liquid financial, but also inclined to bring out the possibility that illiquid wealth can be a driving power of precautionary saving.

liquidating housing wealth would have a monetary cost and some waiting time before the liquidity comes through, it would be expected that rational homeowners would also make sufficient savings for the short term to buffer against income variation in the near future. I would propose that the hyperbolic discount function offers an explanation for why homeowners do not behave rationally. Households with a hyperbolic discount function have a preference for illiquid wealth over liquid wealth, and a preference for saving for the long term over that for the short term. Owing to an awareness of self-control problems, they accumulate wealth in illiquid forms for the long-term future in order to prevent themselves from splurging out, in that they have a high marginal propensity to consume out of short-term savings, particularly as short-term savings are primarily in liquid forms. These households also favour illiquid wealth because it will generate investment income in the future.

Self-employed households are considered to be more financially vulnerable than employee households. The results show a strong correlation between short-term saving ratio and self-employment status, illustrating that the self-employed households tend to save more for the short term than employee household at the 1% significance level, with a coefficient of 0.021. Thus, it appears that precautionary saving behaviour is evident amongst the self-employed. As shown in Table 6.3, the marginal effects are both strongly significant on the increase in probability of households' having positive short-term savings and on the increase in households' short-term saving ratio if the households have already been making short-term savings, with estimates of 0.096 and 0.009, respectively. Table 6.4 confirms that the weight of the former effect (71.49%) is greater than that of the latter (28.51%).

Accepting that occupational differences reveal discrepancies, in the terms of degree of income volatility, welfare coverage, and employment vulnerability, measuring the correlation between occupations and the short-term saving ratio becomes essential. It is generally observed that, compared with those in the 'plants & machine operatives' sector, households of the 'craft related', 'personal & protective service', and 'sales' occupations with higher income variability tend to save more for the short term at the 5% or 1% significance level, with coefficients of 0.030, 0.028, and 0.032, respectively. This can be explained by these occupations having a high income variance relative to 'plant & machine operatives' (see Table 5.1) as well as unstable income flow.

Households in 'managers & administrators', 'professional', 'associate professional & technical', and 'clerical & secretarial' categories, tend to save more for the short term than those in the 'plant and machine operatives' sector at the 5% or 10% significance level, with coefficients of 0.023, 0.021, 0.021, and 0.020 respectively. This suggests that: 1) as every occupation group has higher income variance than the 'plant & machine operative' sector, households of all occupation group tend to save more for the short term, in order to buffer income variations in the short run; 2) meanwhile, such tendency is lessened amongst those groups with also higher average income than the 'plant and machine operative' sector, such as the 'managers & administrators', 'professional', and 'clerical & secretarial' categories. As exhibited in Table 6.3, the marginal effects on the increase in possibility of positive short-term savings emerge more statistically significant than those on the increase in short-term saving ratio, if the households have already been making savings, in the occupations 'associate professional & technical', 'craft related', and 'sales'. Given that both effects are generally evident, Table 6.4 confirms that the magnitudes of the former effects range between 68.33% and 71.49%, and those of latter group vary between 28.51% and 31.67%.

It is only weakly significant that households with full-time jobs tend to save more for the short term than those with part-time work, with a coefficient of 0.007. The marginal effect of full-time employment is only weakly significant on an increase in the saving ratio, with an estimate of 0.003, if these workers have already been making savings for the short term.

The findings in the first stage indicated that females are more likely to save mainly for the short term. The estimates here, however, show that the effect of gender difference on the short-term saving ratio is not statistically significant.

Being a key indicator of one's socioeconomic identification, one's educational attainment is considered to be an important factor that has an influence on one's saving behaviour. For instance, highly-educated people can behave more prudently. The findings show that the households with a first degree or a postgraduate degree, tend to save less than their counterparts at the 5% or 1% significance levels, with coefficients of -0.010 and -0.022, respectively. In Table 6.3, results show that highly-educated households, not only are disinclined to save for the short term, but also save less if they

have already been saving for the short term. As mentioned in chapter 5, this can be explained by highly educated people being more likely to have a job with a better financial prospect and welfare coverage. Moreover, the effects of having a postgraduate degree, with estimates of -0.106 and -0.009, are more compelling than those for a first degree, with estimates of -0.047 and -0.004. Table 6.4 shows that, in general, the effects on households' having a positive short-term saving ratio come out of greater magnitude than those on adjustments to their short-term saving ratio.

Permanent income serves as a proxy for a household's wealth level. According to Milton Friedman's *permanent income hypothesis*, permanent income is determined by a consumer's assets: physical (shares, bonds, property) and human (education and experience). These identify his/her ability to earn income. The estimated results show that the households with higher wealth levels tend to save less for the short term at the 1% significance level, with a coefficient of -4.31e-07, and this could be because they have enough wealth stock to manage financial uncertainty in the short run. The marginal effects of permanent income on the decrease in the probability of households' having positive short-term savings and those on the decrease in households' short-term saving ratio, if the households have already been saving, are strongly significant, with estimates of -2.07e-06 and -1.81e-07, respectively. Table 6.4 shows that, of the total marginal effects, the effect on decrease in possibility covers 72.07%, and the effect on the drop in short-term saving ratio is 27.93%.

Age effects, indicated by the variable 'age' and 'age^2', are statistically significant, with coefficients of -0.003 and 0.00003 respectively. The results exhibit a U shape, showing a nonlinear relationship of saving ratio when plotted against the working life cycle[98]. This suggests that the young cohorts save more for short term, because they are most likely to be liquidity constrained, and the cohorts close to retirement save more, as they expect a drop in their income. Given that the two effects are both significant, the marginal effect of age on the change in the probability of households' having short-term saving is of greater magnitude than that on a change in households' short-term saving ratio if they have already made savings.

[98] The working life cycle here refers to the life span between age 25 and age 65.

The characteristics of a household that emerge as significant in affecting its tendency to save for the short term are: first, the households with young dependents (children) tend to save less at the 1% significance level, with a coefficient of -0.010; second, households with a spouse/partner in employment tend to save less, with a coefficient of -0.012 at the 1% significance level. The first finding implies that these households have limited disposable income to be put away after paying bills and expenses on children, whereas the second finding suggests that such households save less for the short term, because having a joint income source they are less likely to consider short-term income uncertainty as a huge impact. It is also found that households with fewer members tend to save less for the short term. Table 6.3 confirms that the marginal effects of the above variables on the decrease in probability of households' having short-term savings and those on the decrease in short-term saving ratio, if the households have already made savings, are evident. Table 6.4 shows that the magnitudes of the former effects, i.e. 73.39%, 72.29%, 73.39%, and 74.42% respectively, are higher than those of the latter effects.

Residential area captures geographic effects. The estimates show that residents in the West Midlands, Tyne & Wear, Greater Manchester, and Wales tend to save more for the short term than those in other areas at the 5% or 1% significance levels, with coefficients of 0.019, 0.024, 0.018, and 0.011 respectively. As shown in Table 6.4, the marginal effects on the change in probability of households' having positive short-term savings are, in general, greater in magnitude than those on the change in short-term saving ratio, if the households have already made savings for the short term.

6.3.2 Long-term saving ratio

The coefficients for subjectively perceived short-term uncertainty are not evident at the 10% significance level, and this confirms that households' long-term saving ratio is not influenced by financial uncertainty in the short term.

The results show that households that consider this year's financial situation to be better than last year tend to save more for the long term at the 1% significance level, with a coefficient of 0.008. In addition, those who think they are currently 'living comfortably' or 'doing alright', tend to save more for the long term at the 1% significance level, with

a coefficient of 0.022. In Table 6.3, the estimated marginal effects generated by the better-off financial realisation and good current financial status are all strongly significant on the increase in possibility of households having positive long-term savings, with estimates of 0.031 and 0.09 respectively, and on the increase in long-term saving ratio if households have already been saving, with coefficients of 0.004 and 0.01 respectively. Table 6.4 reports the relative magnitude of the two effects: 62.35% and 65.77% for the former effects and 37.65% and 34.23% for the latter.

Regarding a finding in Guariglia (2001) that households who perceived their current financial situation to be good tended to save more, the finding here extends this view and proposes that households with these circumstances tend to put more money away for long-term purposes rather than for the short-term purposes.

Possession of housing wealth does not make a difference in households' long-term saving ratio. By contrast, results show that those who have paid into private pension schemes tend to save more for the long term at the 5% significance level, with a coefficient of 0.006; this indicates that their having a long-term planning horizon, is also reflected in their having higher discretionary savings for the long-term future, than their counterparts. This finding suggests that accumulating pension wealth has no substitute effect on the building up of discretionary wealth. Katona (1965) stated that social security and private pension wealth may increase the desire to save, because being closer to one's goal represents a psychological force that enhances motivation for making savings, whereas motivation is weakened when it appears impossible or very difficult to reach a goal. Table 6.3 confirms that pension participants are not only inclined to save for the long term, but also make more long-term savings than non-pension participants, if they have already been making saving to this end. As shown in Table 6.4, the effect on the increase in possibility of households' having a long-term saving ratio is greater in magnitude than that on the increase in long-term saving ratio, i.e. 62.35% and 37.65% respectively.

Self-employed households tend to save more for the long term than employee households at the 1% significance level, with a coefficient of 0.036. Table 6.3 confirms that, compared with employees, the self-employed are not only more likely to save for the long term but also have higher long-term saving ratio, with estimates of 0.134 and

0.018. Table 6.4 further shows that the marginal effect on the increase in possibility of the self-employed households' having long-term savings is larger in scale than that on the increase in long-term saving ratio, if they have already been making long-term savings, 62.35% and 37.65% respectively.

Negative association between occupation and long-term saving ratio is observed on all occupational types at the 5% or 1% significance levels, i.e. compared with those in the 'plants and machine operatives' sector, households of all occupational categories tend to save less for the long term. The results show that, compared with those in the '' those in 'craft related', 'personal and protective service', and 'sales' occupations tend to save less for the long term at the 1% significance level, with coefficients of -0.041, -0.056, and -0.046 respectively. Those in the other occupations tend to do so mostly at the 5% significance level, with coefficients ranging between -0.026 and -0.032. The estimated marginal effects in Table 6.3 report that households in these occupations not only are disinclined to make long-term savings, but also have lower savings for long-term purposes if they have already been making savings. Table 6.4 shows that the effects on the decrease in possibility of households' having long-term savings are greater in magnitude than those on the reduction in long-term saving ratio.

Female households tend to save less for the long term than male households at the 1% significance level, with a coefficient of -0.023. In comparison with the finding in chapter 5 that female households had a stronger short-term saving motive than male households, the result here could have two explanations. Firstly, whilst previously only the saving motives of heads of household were taken into account, saving ratio here allows for the saving preference of each individual within a household. Secondly, the current finding can reinforce the previous estimation on the likelihood in a proposition that females' tendency to save for the short term (disinclination to save for the long term) is reflected by possessing lower long-term savings. In general, the findings verify that females have a shorter planning horizon when making savings decisions than males, and short-term precautionary saving behaviour is more likely to be observed amongst females. Table 6.3 suggests that, when compared with males, females are not only are averse to saving for the long term, but also make fewer savings for the long term, if their households have already been making saving, with estimates of -0.096 and -0.01

respectively. Table 6.4 shows that the former effect is greater in magnitude than the latter.

Households with a first degree or a postgraduate degree tend to save more for the long term at the 1% significance level, and those with a postgraduate degree save more than those with a first degree, with coefficients of 0.022 and 0.015 respectively. Highly educated households are not only more likely to save for the long term, but also save more if they have already been saving. This can be explained by highly educated people being more prudent than the lowly-educated. Table 6.4 indicates the effects on the rise in possibility of households' having long-term saving ratio are of greater magnitude than those on an increase in households' long-term saving ratio.

Several indicators for life-cycle factors do not have an impact on the long-term saving ratio: age, household size, and permanent income. On the other hand, households that have young dependents tend to save less for the long term at the 1% significance level, with a coefficient of -0.017, and this suggests that young dependents take up a significant portion of expenditure, so these households have less money to put away. Households with joint income sources tend to save more for the long term at the 1% significance level, with a coefficient of 0.011. Table 6.4 exhibits that the estimated marginal effects of young dependents and joint income are greater on changes in possibility of households' having long-term savings, than on changes in long-term saving ratio.

The estimates indicate that households living in the Greater London, East, Scotland, and North Ireland regions, tend to save more for the long term at the 5% or at the 10% significance level, with coefficients of 0.016, 0.020, 0.010, and 0.016 respectively, and households living in the West Midland, tend to save less at the 10% significance level, with a coefficient of 0.013. Table 6.3 confirms the existence of geographical effects not only on the change in the possibility of households having positive long-term savings, but also on the change in long-term saving ratio, if they have already been making savings to this end. Table 6.4 shows that the effects on the change in the possibility of positive long-term savings are greater than those on the change in the long-term saving ratio.

Table 6.2: Random effect Tobit estimates of saving ratio - At whole sample level

		Short-term saving ratio		*Long-term saving ratio*	
Independent Variables	*Mean*	*Coef.*	*Std Dev.*	*Coef.*	*Std Dev.*
Constant		0.118***	0.027	0.009	0.030
Permanent income	34874.81	-4.31e-07***	8.43e-08	7.96e-08	9.04e-08
Financial expectation					
Better-off	0.323	-0.001	0.002	0.003	0.002
Worse-off	0.074	0.004	0.004	0.000	0.004
Financial situation					
Good	0.847	0.004	0.003	0.022***	0.003
Bad	0.018	-0.002	0.008	-0.011	0.009
Financial realisation					
Better-off	0.404	0.006***	0.002	0.008***	0.002
Worse-off	0.144	-0.004	0.003	-0.004	0.003
Pension enrolment	0.264	-0.001	0.003	0.006**	0.003
Homeownership	0.862	-0.009***	0.003	-0.001	0.004
Female	0.223	0.002	0.004	-0.023***	0.004
Habit effects	0.427	-0.018***	0.002	0.000	0.002
Age	42.2	-0.003***	0.001	0.000	0.001
Age squared	1880.493	0.00003**	0.00001	1.12e-06	0.000
Education					
Higher than first degree	0.06	-0.022***	0.006	0.022***	0.007
First degree	0.174	-0.010**	0.004	0.015***	0.005
Some college	0.341	-0.005	0.003	0.005	0.004
A Level	0.119	-0.002	0.004	0.002	0.005
Married/Cohabiting	0.733	-0.003	0.004	0.008	0.005
Self-employed	0.108	0.021***	0.005	0.036***	0.005
Spouse/partner employed	0.399	-0.012***	0.004	0.011***	0.004
Full-time employed	0.925	0.007*	0.004	-0.007	0.005
Occupation					
Managers & Administrators	0.257	0.023**	0.011	-0.029**	0.012
Professional	0.093	0.021*	0.012	-0.026**	0.012
Associate professional & Technical	0.137	0.021*	0.011	-0.030**	0.012
Clerical & Secretarial	0.186	0.020*	0.011	-0.032***	0.012
Craft related	0.245	0.030***	0.011	-0.041***	0.012
Personal & Protective services	0.023	0.028**	0.013	-0.056***	0.014
Sales	0.048	0.032***	0.012	-0.046***	0.013
With children	0.406	-0.010***	0.004	-0.017***	0.004
Household size					
1-2 members	0.488	-0.020***	0.006	0.001	0.006
3-4 members	0.43	-0.013***	0.004	0.005	0.005
Residential area					
Greater London	0.052	-0.001	0.006	0.016**	0.007
South West	0.054	0.005	0.006	0.011	0.007
East	0.078	-0.002	0.006	0.020***	0.006
West Midlands	0.05	0.019***	0.006	-0.013*	0.008
Greater Manchester	0.024	0.018**	0.009	0.009	0.010
North West	0.044	0.008	0.007	-0.007	0.008
Yorkshire & Humberside	0.059	0.007	0.006	0.003	0.007
Tyne & Wear	0.041	0.024***	0.007	-0.009	0.008
Wales	0.139	0.011**	0.005	0.005	0.006
Scotland	0.195	0.001	0.004	0.010**	0.005
Northern Ireland	0.134	0.006	0.005	0.016***	0.006
Year dummy					

1999-2000	-0.010***	0.003	0.004*	0.003
2000-2001	-0.008***	0.002	0.003	0.003
2001-2002	-0.008***	0.002	0.008***	0.003
/sigma_v	0.051***	0.001	0.064***	0.001
/sigma_e	0.062***	0.001	0.065***	0.001
LR Chi2 (45)	330.46		432.83	
Prob > Chi2	0.000		0.000	
Rho (ρ) value	0.400	0.017	0.488	0.015
Observation Summary				
Censored observations	2410		1777	
Uncensored observations	4787		5420	

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Table 6.3: Marginal effect estimates – At whole sample level

	Short-term saving ratio			*Long-term saving ratio*		
Independent Variables	*Aggregate effect*	*Prob(y>0)*[99]	*Change of y above zero*	*Aggregate effect*	*Prob(y>0)*	*Change of y above zero*
Permanent income	-4.31e-07***	-2.07e-06***	-1.81e-07***	7.97e-08	3.21e-07	3.67e-08
Financial expectation						
Better-off	-0.001	-0.003	-0.0003	0.003	0.012	0.001
Worse-off	0.004	0.018	0.002	0.0004	0.002	0.0002
Financial situation						
Good	0.004	0.018	0.00	0.022***	0.09***	0.01***
Bad	-0.002	-0.009	-0.001	-0.011	-0.044	-0.005
Financial realisation						
Better-off	0.006***	0.027***	0.002**	0.008***	0.031***	0.004***
Worse-off	-0.004	-0.021	-0.002	-0.004	-0.016	-0.002
Pension enrolment	-0.001	-0.006	-0.001	0.006**	0.025**	0.003**
Homeownership	-0.009***	-0.044***	-0.004***	-0.001	-0.005	-0.001
Female	0.002	0.010	0.001	-0.023***	-0.096***	-0.01***
Habit effects	-0.018***	-0.084***	-0.007***	0.0004	0.002	0.0002
Age	-0.003***	-0.015***	-0.001***	0.0005	0.002	0.0002
Age squared	0.00003**	0.0001**	0.00001**	9.41e-07	4.52e-06	5.16e-07
Education						
Higher than first degree	-0.022***	-0.106***	-0.009***	0.022***	0.085***	0.011***
First degree	-0.010**	-0.047**	-0.004**	0.015***	0.059***	0.007***
Some college	-0.005	-0.024	-0.002	0.005	0.019	0.002
A Level	-0.002	-0.012	-0.001	0.002	0.008	0.001
Married/Cohabiting	-0.003	-0.014	-0.001	0.008	0.033	0.004
Self-employed	0.021***	0.096***	0.009***	0.036***	0.134***	0.018***
Spouse/partner employed	-0.012***	-0.058***	-0.005***	0.011***	0.043***	0.005***
Full-time employed	0.007*	0.035	0.003*	-0.008	-0.029	-0.003
Household size						

[99] *y denotes the dependent variable.*

1-2 members	-0.020***	-0.094***	-0.008***	0.001	0.004	0.0004
3-4 members	-0.013***	-0.061***	-0.005***	0.005	0.018	0.002
Occupation						
Managers & Administrators	0.023**	0.109**	0.01**	-0.029**	-0.121**	-0.013***
Professional	0.021*	0.097*	0.009*	-0.026**	-0.109**	-0.011**
Associate professional & Technical	0.021*	0.099**	0.01*	-0.030**	-0.126**	-0.013***
Clerical & Secretarial	0.020*	0.096*	0.009*	-0.032***	-0.135***	-0.014***
Craft related	0.030***	0.139***	0.013**	-0.041***	-0.173***	-0.018***
Personal & Protective services	0.028**	0.128**	0.013**	-0.056***	-0.241***	-0.022***
Sales	0.032***	0.143***	0.015**	-0.046***	-0.194***	-0.018***
With children	-0.010***	-0.049***	-0.004***	-0.017***	-0.071***	-0.008***
Residential area						
Greater London	-0.001	-0.003	-0.0003	0.016**	0.063**	0.008**
South West	0.005	0.025	0.002	0.011	0.043	0.005
East	-0.002	-0.009	-0.001	0.019***	0.076***	0.009***
West Midlands	0.019***	0.09***	0.009***	-0.013*	-0.053*	-0.006*
Greater Manchester	0.018**	0.082**	0.008*	0.009	0.036	0.004
North West	0.008	0.037	0.003	-0.007	-0.027	-0.003
Yorkshire & Humberside	0.007	0.032	0.003	0.003	0.013	0.002
Tyne & Wear	0.024***	0.11***	0.011***	-0.009	-0.038	-0.004
Wales	0.011**	0.054**	0.005**	0.005	0.019	0.002
Scotland	0.001	0.006	0.001	0.010*	0.04**	0.005*
Northern Ireland	0.006	0.027	0.002	0.015***	0.061***	0.007***
Year dummy						
1999-2000	-0.010***	-0.048***	-0.004***	0.004*	0.018*	0.002
2000-2001	-0.008***	-0.039***	-0.003***	0.003	0.014	0.002
2001-2002	-0.008***	-0.041***	-0.003***	0.008***	0.031***	0.004***
Estimated probability of saving ratio being positive		0.598			0.657	
Estimated mean conditional upon saving ratio being positive			0.072			0.088

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Table 6.4: Relative magnitude estimates of marginal effect – At whole sample level

	Short-term saving ratio		Long-term saving ratio	
Independent Variables	*Prob(y>0)*	*Change of y above zero*	Prob(y>0)	Change of y above zero
Permanent income	72.07%	27.93%	--	--
Financial expectation				
Better-off	--	--	--	--
Worse-off	--	--	--	--
Financial situation				
Good	--	--	65.77%	34.23%
Bad	--	--	--	--
Financial realisation				
Better-off	77.83%	22.17%	62.35%	37.65%
Worse-off	--	--	--	--
Pension enrolment	--	--	62.35%	37.65%
Homeownership	70.44%	29.56%	--	--
Female	--	--	67.26%	32.74%
Habit effects	74.13%	25.87%	--	--
Age	77.83%	22.17%	--	--
Age squared	77.83%	22.17%	--	--
Education				
Higher than first degree	72.79%	27.21%	62.35%	37.65%
First degree	73.39%	26.61%	64.86%	35.14%
Some college	--	--	--	--
A Level	--	--	--	--
Married/Cohabiting	--	--	--	--
Self-employed	71.49%	28.51%	62.35%	37.65%
Spouse/partner employed	72.29%	27.71%	65.77%	34.23%
Full-time employed	--	100%	--	--
Occupation				
Managers & Administrators	71.08%	28.92%	66.24%	33.76%
Professional	71.49%	28.51%	68.14%	31.86%
Associate professional & Technical	68.33%	31.67%	67.37%	32.63%
Clerical & Secretarial	70.07%	29.93%	67.05%	32.95%
Craft related	71.18%	28.82%	66.94%	33.06%
Personal & Protective services	69.12%	30.88%	70.41%	29.59%
Sales	68.82%	31.18%	70.53%	29.47%
With children	73.39%	26.61%	64.56%	35.44%
Household size				
1-2 members	73.39%	26.61%	--	--
3-4 members	74.42%	25.58%	--	--
Residential area				
Greater London	--	--	62.35%	37.65%
South West	--	--	--	--
East	--	--	64.33%	35.67%
West Midlands	68.49%	31.51%	65.24%	34.76%
Greater Manchester	70.44%	29.56%	--	--
North West	--	--	--	--
Yorkshire & Humberside	--	--	--	--
Tyne & Wear	69.51%	30.49%	--	--
Wales	69.77%	30.23%	--	--
Scotland	--	--	62.35%	37.65%
Northern Ireland	--	--	64.86%	35.14%
Year dummy				
1999-2000	73.39%	26.61%	100%	--

2000-2001	75.06%	24.94%	--	--
2001-2002	75.06%	24.94%	62.35%	37.65%

6.3.3 Summary

In general, contrasting the estimation results of the two types of saving ratio brings the conclusion that determinants of households' savings from a short planning horizon and those from a long planning horizon should be examined separately, because some differences do exist.

Short-term financial expectations do not affect either the short-term saving ratio or long-term saving ratio, and this finding implies that precautionary saving effect from a short-term perspective is not significant at the 10% significance level in terms of the relationship between the short-term saving ratio and subjectively-perceived risk. Households with this year's financial situation better than last year tend to save more for both the long term and the short term. Households whose savings are mainly driven by habit, tend to have a lower short-term saving ratio than those with a specific reason for saving, whereas habit effect is not evident on households' long-term saving ratios. These findings support the behavioural models in that, firstly, hyperbolic consumers, when having no specific purposes for saving, are too impatient to control expenditure for the short term, but are able to manage this goal for the long term; secondly, households, who exercise mental accounting, may allocate savings for specific reasons into accounts with a lower propensity to consume.

Homeowners' average short-term saving ratio is lower than that of their counterparts, and this suggests a robust connection between short-term discretionary saving and housing wealth. Two explanations can be offered: firstly, housing wealth provides implicit liquidity, so households feel it less necessary to put away money for the short term; secondly, this demonstrates hyperbolic discounting behaviour in which these households tend to possess short-term savings at lower levels and meanwhile engage in illiquid housing wealth. Moreover, homeownership does not affect households' long-term saving ratio, and this supports the preceding point, in that households are too impatient to have short-term savings, but are still rational so as to manage long-term discretionary savings. Pension enrolment only has an impact on increasing a household's long-term saving ratio. This indicates that there is no evident substitute effect of pension wealth in the accumulation of financial wealth for long-term purposes.

In addition, this confirms that pension participants exhibit a longer planning horizon for savings decisions than their counterparts.

Precautionary saving behaviour may be evident in self-employed households or households in certain occupations. Self-employed households tend to save more for both the long term and the short term than employee households. This verifies that the self-employed households have more discretionary savings, which is in line with the notion that the self-employed should save more money in liquid financial assets than employees, owing to the higher degree of financial vulnerability. Households in the 'sales', 'personal & protective services', and 'craft related' occupations, tend to save more for the short term and less for the long term, than households in other occupations. These occupations are considered to generate instable income flow; thus, the findings suggest that the households with these jobs have a higher concern with their short-term future, than the long-term, and this can demonstrate a precautionary motive.

Socioeconomic factors demonstrate significant impacts on saving ratio. Female households tend to save less for the long term than male households, whilst gender plays no part in differences in households' short-term saving ratio. Highly educated households tend to save less for the short term and save more for the long term. This suggests that they have a longer horizon savings plan than their counterparts. It is found that as its wealth level increases, the short-term saving ratio of a household decreases. It is shown that many life-cycle factors are more influential on households' short-term saving behaviour than on their long-term saving behaviour. Age and household size affect only households' short-term saving ratio. Factors like having young dependents and joint incomes, affect both long-term and short-term saving ratios.

In most cases, the corresponding estimated marginal effects on the changes in the possibility of households having a positive saving ratio and those on the changes in saving ratio, if households have already been making saving are evident. In addition, of the total marginal effects, the effects on the possibility of households' having a positive saving ratio are greater than those on adjustments to households' saving ratios, if they have already been saving.

6.4 EMPIRICAL ANALYSIS AND RESULTS - AT THE SUB-SAMPLE LEVEL

The estimated results of the two subgroups will be discussed: private pension participants and homeowners. Private pension enrolment captures the commitment to saving for retirement, and possession of homeownership portrays illiquidity and potential investment benefits in the long run. Both of them are considered as external saving commitments, but the difference is that housing wealth can generate collateralised liquidity whereas pension wealth does not.

6.4.1 Short-term saving ratio

As shown in Table 6.5, the estimated rho (ρ) value of the pension participants group is 0.352, and 0.398 for the homeowners group, indicating that 35.2% of variations in pension participants' short-term saving ratio is attributed to unobserved household characteristics, and 39.8% for homeowners.

In both the pension participants group and the homeowners group, those who expect less short-term uncertainty – financially better off next year – could save less for the short term, according to the coefficients, which are -0.006 and -0.001 respectively. Those who expect higher uncertainty – financially worse off next year – could save more, with coefficients 0.007 and 0.005 respectively. However, these coefficients are not different to zero at the 10% significance level, thus the relationships between financial expectations and short-term saving ratio do not hold. This means that precautionary saving effect cannot be found.

On the other hand, households who perceive themselves to be financially better off this year than last year tend to save more for the short term at the 10% significance level for both groups, with coefficients of 0.008 and 0.004, respectively. The estimated marginal effects of better-off financial realisation on a rise in the possibility of households having positive short-term savings and on an increase in short-term saving ratio, if the households have already been making savings for the short term, are significant at the 10% significance level. As shown in Table 6.7, the effect in the former case is of greater magnitude than in the latter one.

Only homeowners in a bad current financial situation tend to save less for the short term at the 10% significance level, with a coefficient of -0.016. The estimated marginal effects reported are only weakly significant, and the relative magnitude of the effect on a decrease in the possibility of households having short-term savings, shown in Table 6.7, appears greater than that of the effect on a decrease in the short-term saving ratio.

Households that save primarily for no specific reason tend to save less for the short term at the 1% significance level in both groups, with the coefficient of -0.021 for pension participants larger than that of -0.016 for homeowners. These show that both pension participants and homeowners, who mainly practice routine saving, save less for the short term, than those who save for specific purposes. These results are consistent with the findings at the whole sample level, and similarly, the implications of the behavioural models are provided as explanations. Table 6.6 exhibits that these households not only are disinclined to save for the short term but also save less if they have already been making savings. Table 6.7 confirms that, of the marginal habit effect, the effect in the former case is of greater magnitude than in the latter.

In both groups, the self-employed households tend to save more for the short term at the 1% significance level, with coefficients of 0.028 for pension participants and 0.021 for homeowners. This indicates that even though they have owned collateralised liquidity or they have been saving for retirement, the self-employed still save more for the short term than employees. This is a result which favours precautionary saving behaviour. As shown in Table 6.6, the marginal effects of self-employment on a rise in the possibility of having positive short-term savings and on an increase in the short-term saving ratio are all robust in both groups, and the effects on pension participants are more profound than those on homeowners. Table 6.7 further shows that the magnitudes of the effects in the former case are generally greater than in the latter.

Occupational effects appear more comprehensive on the homeowners' short-term saving ratio than on that of pension participants. Pension participants in the 'craft related' sector tend to save more for the short term at the 5% significance level, and those in the 'personal & protective services' sector tend to save more at the 10% significance level, with coefficients of 0.036 and 0.045 respectively. Homeowners in all

occupation groups tend to save more for the short term than those in the 'plants & machine operatives' sector. Moreover, those in 'craft related', 'personal & protective services', and 'sales', who have less stable income flow, tend to save more, with coefficients of 0.041, 0.042, and 0.042, respectively. Those in 'managers & administrators', 'professional', 'associate professional & technical', and clerical & secretarial' occupations, also tend to save more for the short term, with coefficients of 0.035, 0.032, 0.033, and 0.033, which are lower than the previous groups. Hence the findings for both groups confirm that households, who hold housing wealth or pension wealth, still save more for the short term if their occupations generate higher income volatility. Table 6.6 shows that, amongst pension participants, the estimated marginal effects of occupations are more evident on the rise in the possibility of households having positive short-term savings than on an increase in the short-term saving ratio. By contrast, amongst homeowners, the estimated effects of all occupations are strongly significant, not only on the rise in possibility of having positive short-term savings but also on an increase in the short-term saving ratio. Table 6.7 indicates that the situation that, across all occupations and in both groups, the magnitudes of the effects in the former case are in general greater than in the latter.

Homeowners in full-time employment tend to save more for the short term at the 10% significance level, with a coefficient of 0.008. These two marginal effects are both weakly significant, and the effect on an increase in the possibility of households having short-term savings appears greater in scale than that on an increase in the short-term saving ratio.

Homeownership does not have an impact on pension participants' short-term saving ratio, and nor does pension-enrolment on homeowners' short-term saving ratio.

The gender effect appears as insignificant on the short-term saving ratio for both groups. Higher education is significantly influential on the short-term saving ratio in both groups. Pension participants with a postgraduate degree tend to save less at the 1% significance level, with a coefficient of -0.046, and homeowners with a postgraduate degree or a first degree tend to save less at the 5% significance level, with coefficients of -0.020 and -0.009. As displayed in Table 6.6, the marginal effects of educational attainment on the drop in possibility of households having positive short-term savings

and on a decrease in households' short-term saving ratio are significantly robust for both groups. Table 6.7 confirms that, concerning these marginal effects, the sizes of effects in the former case come out larger than in the latter.

Those with a higher wealth level (permanent income) tend to save less for the short term at the 1% significance level, with a coefficient of -3.90e-07 for pension participants and -3.96e-07 for homeowners. Amongst both groups, these households are not only disinclined to save for the short term, but also save less if they have already been making short-term savings. Table 6.7 shows that the relative magnitudes of the effects of wealth level on the decrease in possibility of having positive short-term savings are larger than on the decline in the short-term saving ratio.

Life-cycle factors - age, young dependents, household size, and joint income sources - are evidently correlated, either positively or negatively, with the short-term saving ratio for both groups. Households with fewer family members tend to save less for the short term, with coefficients of -0.035 and -0.016 for pension participants and -0.021 and -0.014 for homeowners. Those with joint income sources tend to save less at the 5% significance level, with a coefficient of -0.017 for pension participants and -0.013 for homeowners. Households with young dependents tend to save less at the 5% significance level, with coefficients of -0.020 and -0.010 respectively. A non-linear age effect across the working life cycle appears as evident in both groups, in particular pension participants: households tend to save more for the short term during young age and during ages close to retirement. As shown in Table 6.6, the estimated marginal effects of these life-cycle factors are evident, both on the possibility of households having short-term savings and on the changes in short-term savings, if households have already been making savings for this purpose. Table 6.7 further confirms that the scales in the former cases are greater than in the latter.

Both pension participants and homeowners living in the West Midlands, Greater Manchester, Tyne & Wear, and Wales regions, tend to save more for the short term, with coefficients of 0.027, 0.038, 0.044, and 0.022 for pension participants and 0.020, 0.015, 0.025, and 0.010 for homeowners. In addition, pension participants living in Yorkshire & Humberside, Scotland, and Northern Ireland tend to save more for the short term, with coefficients of 0.023, 0.022, and 0.026. Amongst pension participants,

the geographical marginal effects of the areas Greater Manchester, Tyne & Wear, Yorkshire & Humberside, and Northern Ireland on the increase in the possibility of households having positive short-term savings, are more evident than those on the increase in the short-term saving ratio. Amongst homeowners, this is also the case for those living in the Greater Manchester area. Table 6.7 shows that the magnitudes of effects on the changes in the possibility of having positive short-term savings are greater than those on the changes in the short-term saving ratio.

6.4.2 Long-term saving ratio

The estimated rho (ρ) value of the pension participants group is 0.452, and 0.516 for the homeowners group, showing that a very high proportion – 45.2% and 51.6% respectively - of variations in their long-term saving ratio are captured by unobserved household characteristics.

Results show that financial expectations do not have an impact on households' long-term saving ratio in both groups. By contrast, both pension participants and homeowners, with good current financial status, tend to save more for the long term at the 1% significance level, with coefficients of 0.026 and 0.021, respectively. Pension participants who perceive themselves to be financially worse off this year than last year, tend to save less for the long term at the 5% significance level, with a coefficient of -0.016; in comparison, homeowners who perceive themselves to be financially worse off, tend to save less for the long term at the 10% significance level, with a coefficient of -0.006, and those who perceive themselves to be financially better off than last year, tend to save more for the long term at the 1% significance level, with a coefficient of 0.007. As displayed in Table 6.6, these financial marginal effects are both evident on the changes in the possibility of households having long-term savings and on adjustments to the long-term saving ratio. Table 6.7 exhibits the relative magnitudes of the two effects: in general, the effects on the possibility of households having positive long-term savings come out in greater size than the effects on the magnitude of the long-term saving ratio.

Pension participants who also own housing wealth tend to save less for the long term at the 10% significance level than those who do not, with a coefficient of -0.018. This indicates that housing wealth can have a substitute effect on pension participants' long-

term discretionary savings, but this correlation is only weakly significant. On the other hand, homeowners who are accumulating pension wealth do not tend to save differently to their counterparts, in terms of the long-term saving ratio. For pension participants, the marginal effect of homeownership appears more evident on the drop in the possibility of households having long-term savings than on the decrease in the long-term saving ratio, if they have already been making savings for the long term. Table 6.7 reports the relative scales of the two effects: 60.8% and 39.2%.

In both groups, self-employed households tend to save more for the long term at the 1% significance level than employees, with coefficients of 0.044 for pension participants and 0.039 for homeowners. This suggests that self-employed households, even if they have held housing wealth or pension wealth, still tend to have a higher discretionary long-term saving ratio. Along with the finding that they, the self-employed, also tend to save more for the short term, a conclusion emerges: the self-employed save more financial discretionary wealth than employees for both long-and short-term planning horizons. The estimated marginal effects of self-employment on a rise in the possibility of households having long-term savings and those on an increase in the long-term saving ratio are strongly evident in both groups. Table 6.7 indicates that the magnitudes of the effects in the former case – 60.80% and 58.58% - are greater than those in the latter – 39.20% and 41.42%.

Only homeowners in full-time employment tend to save less for the long term at the 5% significance level, with a coefficient of -0.011. The marginal effects of full-time employment are significant both on a change in the possibility of households having positive long-term savings and on a change in the long-term saving ratio. The effects in the former case are of a greater magnitude than those in the latter.

In both groups, the effects on the long-term saving ratios are only observed in some occupations, but they are more frequently observed for homeowners. Pension participants in the 'personal & protective services' sector tend to save less for the long term at the 10% significance, with a coefficient -0.052. Homeowners in the 'craft related' and 'sales' sectors tend to save less for the long term at the 10% significance level, with coefficients of -0.027 and -0.028 respectively, and those in the 'personal & protective services' tend to save less at the 5% significance level, with a coefficient of -

0.043. As shown in Table 6.6, the marginal effects for the 'personal & protective services' and 'sales' occupations are more significant on a decrease in the long-term saving ratio than on a drop in the possibility of households having long-term savings. Nevertheless, in general, the magnitudes of effects on the possibility of households having positive long-term savings are larger than those of the effects on the long-term saving ratio.

Both female pension participants and female homeowners tend to save less for the long term that their counterparts (males) at the 1% significance level, with coefficients -0.028 and -0.024 respectively. The estimated marginal effects shown in Table 6.6 and Table 6.7 confirm that the effects on a drop in the possibility of households having positive long-term savings and those on a decrease in the long-term saving ratio of the two groups, come out similar.

The effects of higher education on the long-term saving ratio appear to be more evident for homeowners than for pension participants. Pension participants with a first degree or a postgraduate degree tend to save more for the long term only at the 10% significance level, with coefficients of 0.016 and 0.026 respectively, whereas homeowners that hold a first degree or a postgraduate degree tend to save more for the long term at the 5% significance level, with coefficients of 0.013 and 0.018 respectively. In most cases, the marginal effects of higher education are simultaneously significant on an increase in the possibility of households having positive long-term savings and on an increase in the long-term saving ratio. The exceptions are the cases of: having a first degree for pension participants and that of having a postgraduate degree for homeowners. Table 6.7 shows that, in both groups, the effect of having a postgraduate degree is of greater magnitude on increasing long-term savings than on an increase in the possibility of households having long-term savings. By contrast, the effect of having a first degree works the other way around.

Indicators for life-cycle factors show a limited effect on homeowners but no effect on pension participants. Homeowners with young dependents tend to save less for the long term at the 1% significance level, with a coefficient of -0.015, than those without and those with joint income sources tend to save more for the long term at the 1% significance level, with a coefficient of 0.012, than single income households. The

marginal effects of having 'young dependents' and 'joint income sources' appear evident both on changes in the possibility of households having positive long-term savings and on the variations in the long-term saving ratio. Referring to the relative magnitudes in Table 6.7, the effect on the decrease in the possibility of households having long-term savings appears to be of greater magnitude in the case of having 'young dependents', whereas the effect on an increase in the long-term saving ratio, if households have already been making savings for the long term, come out greater in size in the case of having 'joint income sources'.

In both groups, those living in Northern Ireland tend to save more for the long term at the 5% significance level, with coefficients of 0.025 for pension participants and 0.016 for homeowners. In addition, homeowners living in the East area tend to save more for the long term at the 1% significance level, with a coefficient of 0.023, and pension participants in the Greater Manchester tend to save more for the long term at the 10% significance level, with a coefficient of 0.036. Homeowners in the West Midlands tend to save less for the short term at the 10% level, with a coefficient of -0.014. The marginal effects of living in these residential areas on the changes in possibility of households having positive long-term savings and on the changes in long-term saving ratio are, by and large, equally significant, but an exception occurs amongst pension participants as area Greater Manchester, which only has the effect in the former case at the 10% significance level, with an estimate of 0.075. Referring to Table 6.7, for those who live in Northern Ireland, they are more likely to increase their long-term saving ratio than to have positive long-term savings. Amongst pension participants, a similar tendency occurs in Greater Manchester. By contrast, for the people in other residential areas, which have shown significant correlation with long-term savings, there is a greater impact on the change in the possibility of households having positive long-term savings.

Table 6.5: Random-effect Tobit estimates on saving ratio – Pension participants and homeowners

	Private Pension participants					*Homeowners*				
		Short-term saving ratio		*Long-term saving ratio*			*Short-term saving ratio*		*Long-term saving ratio*	
Independent Variables	*Mean*	*Coef.*	*Std Dev.*	*Coef.*	*Std Dev.*	*Mean*	*Coef.*	*Std Dev.*	*Coef.*	*Std Dev.*
Constant		0.150***	0.058	-0.004	0.067		0.109***	0.030	-0.008	0.033
Permanent income	37092.2	-3.90e-07***	1.44e-07	-1.49e-08	1.57e-07	36629.75	-3.96e-07***	8.49e-08	1.22e-07	9.17e-08
Financial expectation										
Better-off	0.32	-0.006	0.005	0.008	0.005	0.312	-0.001	0.002	0.001	0.002
Worse-off	0.071	0.007	0.008	-0.004	0.009	0.077	0.005	0.004	0.0001	0.004
Financial situation										
Good	0.863	0.005	0.007	0.026***	0.008	0.861	0.004	0.003	0.021***	0.004
Bad	0.016	-0.023	0.018	-0.003	0.020	0.015	-0.016*	0.009	-0.003	0.009
Financial realisation										
Better-off	0.4	0.008*	0.005	0.003	0.005	0.393	0.004*	0.002	0.007***	0.002
Worse-off	0.157	-0.004	0.007	-0.016**	0.007	0.148	-0.004	0.003	-0.006*	0.003
Pension enrolment	--	--	--	--	--	0.277	0.001	0.003	0.004	0.003
Homeownership	0.905	0.009	0.009	-0.018*	0.010	--	--	--	--	--
Female	0.142	0.012	0.008	-0.028***	0.010	0.194	0.003	0.004	-0.024***	0.004
Habit effects	0.437	-0.021***	0.004	-0.004	0.005	0.434	-0.016***	0.002	-0.0002	0.002
Age	42.995	-0.006**	0.002	0.002	0.003	42.614	-0.004***	0.001	0.001	0.001
Age squared	1945.186	0.00005*	0.00003	-0.00001	0.00003	1911.407	0.00003***	0.00001	-2.76e-06	0.00002
Education										
Higher than first degree	0.051	-0.046***	0.014	0.026*	0.015	0.063	-0.020***	0.006	0.018**	0.007
First degree	0.185	-0.011	0.008	0.016*	0.010	0.181	-0.009**	0.004	0.013***	0.005
Some college	0.357	-0.013**	0.006	0.001	0.007	0.347	-0.005	0.003	0.002	0.004
A Level	0.114	-0.007	0.009	-0.011	0.010	0.123	-0.003	0.004	0.0002	0.005
Married/Cohabiting	0.785	-0.002	0.010	0.003	0.011	0.769	-0.002	0.005	0.005	0.005
Self-employed	0.236	0.028***	0.007	0.044***	0.008	0.109	0.021***	0.005	0.039***	0.005
Spouse/partner employed	0.362	-0.017**	0.007	0.009	0.008	0.369	-0.013***	0.004	0.012***	0.004
Full-time employed	0.956	0.009	0.011	-0.017	0.012	0.937	0.008*	0.005	-0.011**	0.005
Occupation										
Managers & Administrators	0.309	0.027	0.017	-0.006	0.018	0.274	0.035***	0.014	-0.015	0.014
Professional	0.108	0.024	0.018	-0.019	0.020	0.095	0.032**	0.014	-0.009	0.015

Associate professional & Technical	0.071	0.022	0.019	-0.011	0.020	0.132	0.033**	0.014	-0.014	0.014
Clerical & Secretarial	0.163	0.013	0.018	-0.005	0.019	0.191	0.033**	0.014	-0.017	0.014
Craft related	0.227	0.036**	0.017	-0.026	0.019	0.238	0.041***	0.014	-0.027*	0.014
Personal & Protective services	0.013	0.045*	0.026	-0.052*	0.030	0.016	0.042***	0.016	-0.043**	0.017
Sales	0.086	0.016	0.018	-0.028	0.020	0.047	0.042***	0.015	-0.028*	0.015
With children	0.41	-0.020**	0.008	-0.011	0.009	0.416	-0.010***	0.004	-0.015***	0.004
Household size										
1-2 members	0.458	-0.035***	0.012	0.010	0.014	0.47	-0.021***	0.006	0.002	0.006
3-4 members	0.447	-0.016*	0.009	0.002	0.010	0.444	-0.014***	0.004	0.005	0.005
Residential area										
Greater London	0.043	0.021	0.014	-0.001	0.016	0.047	0.003	0.007	0.012	0.008
South West	0.065	0.017	0.012	0.008	0.014	0.053	0.008	0.007	0.007	0.008
East	0.099	0.009	0.011	0.017	0.012	0.076	-0.004	0.006	0.023***	0.007
West Midlands	0.065	0.027**	0.012	-0.014	0.014	0.052	0.020***	0.007	-0.014*	0.008
Greater Manchester	0.021	0.038**	0.019	0.036*	0.022	0.024	0.015*	0.009	0.014	0.010
North West	0.042	0.022	0.014	0.006	0.016	0.047	0.006	0.007	-0.006	0.008
Yorkshire & Humberside	0.063	0.023*	0.012	0.002	0.014	0.059	0.004	0.007	0.002	0.008
Tyne & Wear	0.038	0.044***	0.015	-0.021	0.018	0.041	0.025***	0.007	-0.006	0.009
Wales	0.132	0.022**	0.010	0.005	0.011	0.144	0.010**	0.005	0.006	0.006
Scotland	0.152	0.022**	0.009	0.010	0.011	0.191	0.001	0.005	0.008	0.006
Northern Ireland	0.128	0.026***	0.010	0.025**	0.011	0.139	0.004	0.005	0.016***	0.006
Year dummy										
1999-2000		-0.016***	0.006	0.001	0.006		-0.011***	0.003	0.005*	0.003
2000-2001		-0.015***	0.006	-0.002	0.006		-0.008***	0.003	0.002	0.003
2001-2002		-0.012**	0.006	0.010*	0.006		-0.008***	0.003	0.007***	0.003
/sigma_v		0.052	0.003	0.069	0.003		0.049***	0.001	0.063	0.002
/sigma_e		0.071	0.002	0.076	0.002		0.060***	0.001	0.061	0.001
LR Chi2 (44)		130.79		145.38			276.04		374.92	
Prob > Chi2		0.000		0.000			0.000		0.000	
Rho (ρ) value		0.352	0.038	0.452	0.030		0.398	0.018	0.516	0.016
Observation Summary										
Censored observations		695		410			2118		1432	
Uncensored observations		1204		1489			4087		4773	

(***) at the1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Table 6.6: Marginal effect estimates – Pension participants and homeowners

	Short-term saving ratio				*Long-term saving ratio*			
	Pension participants		***Homeowners***		***Pension participants***		***Homeowners***	
Independent Variables	*Prob(y>0)*	*Change of y above zero*	*Prob(y>0)*	*Change of y above zero*	*Prob(y>0)*	*Change of y above zero*	*Prob(y>0)*	*Change of y above zero*
Permanent income	-1.74e-06***	-1.58e-07***	-1.98e-06***	-1.66e-07***	-5.19e-08	-7.09e-09	5.02e-07	5.78e-08
Financial expectation								
Better-off	-0.028	-0.003	-0.007	-0.001	0.027	0.004	0.002	0.0003
Worse-off	0.032	0.003	0.025	0.002	-0.014	-0.002	0.0005	0.0001
Financial situation								
Good	0.024	0.002	0.019	0.002	0.092***	0.012***	0.087***	0.009***
Bad	-0.102	-0.008	-0.082*	-0.006*	-0.01	-0.001	-0.012	-0.001
Financial realisation								
Better-off	0.036*	0.003*	0.021*	0.002*	0.011	0.001	0.03***	0.004***
Worse-off	-0.019	-0.002	-0.019	-0.002	-0.058**	-0.007**	-0.026*	-0.003**
Pension enrolment	--	--	0.005	0.0004	--	--	0.016	0.002
Homeownership	0.038	0.003	--	--	-0.062**	-0.009*	--	--
Female	0.055	0.005	0.016	0.001	-0.101***	-0.013***	-0.1***	-0.011***
Habit effects	-0.095***	-0.009***	-0.081***	-0.007***	-0.015	-0.002	-0.001	-0.0001
Age	-0.023**	-0.002**	-0.018***	-0.002***	0.007	0.001	0.004	0.0004
Age squared	0.0002*	0.000*	0.0002***	0.000***	-5.13e-05	-7.02e-06	-1.13e-05	-1.30e-06
Education								
Higher than first degree	-0.207***	-0.016***	-0.101***	-0.008***	0.086*	0.013*	0.07***	0.009**
First degree	-0.051	-0.004	-0.047**	-0.004**	0.055*	0.008	0.052***	0.006***
Some college	-0.059**	-0.005**	-0.025	-0.002	0.002	0.0003	0.008	0.001
A Level	-0.031	-0.003	-0.014	-0.001	-0.039	-0.005	0.001	0.0001
Married/Cohabiting	-0.007	-0.001	-0.009	-0.001	0.009	0.001	0.021	0.002
Self-employed	0.12***	0.012***	0.101***	0.009***	0.143***	0.022***	0.147***	0.021***
Spouse/partner employed	-0.074**	-0.007**	-0.063***	-0.005***	0.032	0.004	0.047***	0.006***
Full-time employed	0.039	0.003	0.042*	0.003*	-0.056	-0.008	-0.044**	-0.005**

Occupation								
Managers & Administrators	0.119	0.011	0.17***	0.016**	-0.019	-0.003	-0.062	-0.007
Professional	0.103	0.01	0.151**	0.015**	-0.069	-0.009	-0.039	-0.004
Associate professional & Technical	0.097	0.01	0.157***	0.015**	-0.037	-0.005	-0.058	-0.006
Clerical & Secretarial	0.059	0.006	0.157**	0.015**	-0.017	-0.002	-0.073	-0.008
Craft related	0.153**	0.015*	0.193***	0.019***	-0.094	-0.012	-0.113*	-0.012*
Personal & Protective services	0.185**	0.021	0.189***	0.021**	-0.194*	-0.021**	-0.187**	-0.018***
Sales	0.07	0.007	0.19***	0.02**	-0.101	-0.012	-0.122*	-0.012**
With children	-0.089**	-0.008**	-0.049***	-0.004***	-0.038	-0.005	-0.062***	-0.007***
Household size								
1-2 members	-0.157***	-0.014***	-0.106***	-0.009***	0.035	0.005	0.009	0.001
3-4 members	-0.07*	-0.006*	-0.069***	-0.006***	0.007	0.001	0.02	0.002
Residential area								
Greater London	0.093	0.009	0.013	0.001	-0.002	-0.0003	0.048	0.006
South West	0.072	0.007	0.041	0.004	0.026	0.004	0.03	0.004
East	0.04	0.004	-0.019	-0.002	0.057	0.008	0.088***	0.011***
West Midlands	0.117**	0.012**	0.098***	0.009***	-0.05	-0.006	-0.06*	-0.006*
Greater Manchester	0.158**	0.017*	0.075*	0.007	0.114*	0.019	0.055	0.007
North West	0.096*	0.01	0.03	0.003	0.02	0.003	-0.027	-0.003
Yorkshire & Humberside	0.1**	0.01*	0.02	0.002	0.006	0.001	0.007	0.001
Tyne & Wear	0.182***	0.02***	0.119***	0.011***	-0.075	-0.009	-0.027	-0.003
Wales	0.096**	0.009**	0.05**	0.004**	0.017	0.002	0.023	0.003
Scotland	0.094**	0.009**	0.004	0.0003	0.033	0.005	0.034	0.004
Northern Ireland	0.111***	0.011**	0.022	0.002	0.083**	0.013**	0.062***	0.008***
Year dummy								
1999-2000	-0.074***	-0.006***	-0.055***	-0.004***	0.003	0.0004	0.022*	0.003*
2000-2001	-0.067***	-0.006***	-0.041***	-0.003***	-0.008	-0.001	0.01	0.001
2001-2002	-0.055**	-0.005**	-0.043***	-0.003***	0.034*	0.005	0.029***	0.003***
Estimated probability of saving ratio being positive	0.571		0.595		0.678		0.674	
Estimated mean conditional upon saving ratio being positive		0.076		0.102		0.102		0.086

(***) At the 1% significance level; (**) at the 5% significance level; (*) at the 10% significance level

Table 6.7: Relative magnitudes estimates of marginal effect – Pension participants and homeowners

	Short-term saving ratio				*Long-term saving ratio*			
	Pension participants		***Homeowners***		***Pension participants***		***Homeowners***	
Independent Variables	*Prob(y>0)*	*Change of y above zero*	*Prob(y>0)*	*Change of y above zero*	*Prob(y>0)*	*Change of y above zero*	*Prob(y>0)*	*Change of y above zero*
Permanent income	74.31%	25.69%	72.39%	27.61%	--	--	--	--
Financial expectation								
Better-off	--	--	--	--	--	--	--	--
Worse-off	--	--	--	--	--	--	--	--
Financial situation								
Good	--	--	--	--	63.81%	36.19%	67.03%	32.97%
Bad	--	--	75.30%	24.70%	--	--	--	--
Financial realisation								
Better-off	76.22%	23.78%	67.07%	32.93%	--	--	56.04%	43.96%
Worse-off	--	--	--	--	65.70%	34.30%	61.54%	38.46%
Pension enrolment	--	--	--	--	--	--	--	--
Homeownership	--	--	--	--	60.80%	39.20%	--	--
Female	--	--	--	--	63.60%	36.40%	64.74%	35.26%
Habit effect	72.83%	27.17%	71.18%	28.82%	--	--	--	--
Age	78.87%	21.13%	67.07%	32.93%	--	--	--	--
Age squared	74.64%	25.36%	56.09%	43.91%	--	--	--	--
Education								
Higher than first degree	77.95%	22.05%	73.65%	26.35%	60.80%	39.20%	61.54%	38.46%
First degree	--	--	70.73%	29.27%	100%	0%	64.50%	35.50%
Some college	75.61%	24.39%	--	--	--	--	--	--
A Level	--	--	--	--	--	--	--	--
Married/Cohabiting	--	--	--	--	--	--	--	--
Self-employed	72.83%	27.17%	71.77%	28.23%	60.80%	39.20%	58.58%	41.42%
Spouse/partner employed	73.89%	26.11%	74.67%	25.33%	--	--	61.54%	38.46%

Full-time employed	--	--	75.30%	24.70%	--	--	65.04%	34.96%
Occupation								
Managers & Administrators	--	--	69.89%	30.11%	--	--	--	--
Professional	--	--	69.13%	30.87%	--	--	--	--
Associate professional & Technical	--	--	70.06%	29.94%	--	--	--	--
Clerical & Secretarial	--	--	70.06%	29.94%	--	--	--	--
Craft related	73.58%	26.42%	69.48%	30.52%	--	--	65.81%	34.19%
Personal & Protective services	100%	0%	67.07%	32.93%	68.33%	31.67%	67.80%	32.20%
Sales	--	--	68.64%	31.36%	--	--	67.03%	32.97%
With children	74.64%	25.36%	73.65%	26.35%	--	--	64.10%	35.90%
Household size								
1-2 members	74.64%	25.36%	71.77%	28.23%	--	--	--	--
3-4 members	76.62%	23.78%	71.77%	28.23%	--	--	--	--
Residential area								
Greater London	--	--	--	--	--	--	--	--
South West	--	--	--	--	--	--	--	--
East	--	--	--	--	--	--	63.21%	36.79%
West Midlands	71.82%	28.18%	70.36%	29.64%	--	--	67.03%	32.97%
Greater Manchester	71.64%	28.36%	100%	0%	100%	0%	--	--
North West	100%	0%	--	--	--	--	--	--
Yorkshire & Humberside	72.43`%	27.57%	--	--	--	--	--	--
Tyne & Wear	71.18%	28.82%	71.02%	28.98%	--	--	--	--
Wales	74.06%	25.94%	73.65%	26.35%	--	--	--	--
Scotland	74.06%	25.94%	--	--	--	--	--	--
Northern Ireland	73.18%	26.82%	--	--	59.23%	40.77%	61.54%	38.46%
Year dummy								
1999-2000	76.22%	23.78%	76.05%	23.95%	--	--	53.85%	46.15%
2000-2001	74.64%	25.36%	75.30%	24.70%	--	--	--	--
2001-2002	73.58%	26.42%	75.30%	24.70%	100%	0%	67.03%	32.97%

6.4.3 Summary

Amongst both pension participants and homeowners, the impacts of current financial situations and financial realisations emerge to be more significant on the long-term saving ratio than on the short-term saving ratio. As shown in Table 6.8 below, it is clearly observed amongst the two groups that those in a good current financial situation save more for the long term, those in a better financial situation than last year save more for the short term, and those in a financial situation worse than last year save less for the long term.

Table 6.8: Summary of the effects of financial situations

		Short-term saving ratio		*Long-term saving ratio*	
		Pension participants	Homeowners	Pension participants	Homeowners
Financial expectation	Better-off				
	Worse-off				
Current financial status	Good			(+)***	(+)***
	Bad		(-)*		
Financial realisation	Better-off	(+)*	(+)*		(+)***
	Worse-off			(-)**	(-)*

Note: *** at the 1% significance level, ** at the 5%, and * at the 10%.

For both groups, habit effects are only evident on the short-term saving ratio but not on the long-term saving ratio. This reinforces that households save less if the savings for the short term are not motivated by being for particular purposes. Households who save mainly for no specific reason may practice a rule of thumb to control consumption expenditure. However, they tend to save less in that they are too impatient with saving for the short term or such savings are likely to be in an account with a higher propensity to save.

In both groups, the self-employed have a higher long-term saving ratio and a higher short-term saving ratio than do employees. This confirms that even though they possess housing wealth, pension wealth, or both, the self-employed generally have higher discretionary savings than employees. This indicates that amongst both homeowners and pension participants, the self-employed have a stronger precautionary saving motive than employees. In general, occupational influences are more evident on homeowners than on pension participants, and in particular on homeowners' short-term saving ratio. A common finding amongst the two groups is that those in occupations with a

changeable income flow, such as the 'craft related', 'sales', and 'personal & protective services' sectors , tend to save more for the short term and less for the long term, than those in the 'plant and machine operative' sector. The effect of full-time employment is only observed amongst homeowners: full-time employed homeowners tend to save more for the short term and less for the long term, than those homeowners who work part time.

Socioeconomic factors emerge as influential. Gender is strongly associated only with the long-term saving ratio for both groups: female pension participants and female homeowners have a lower long-term saving ratio than their counterparts. Highly educated homeowners tend to save more for the long term and less for the short term, whereas amongst pension participants, the impacts of having had higher education are more evident on the short-term saving ratio than on the long-term saving ratio. In both groups, households with high wealth levels tend to save less for the short term.

Table 6.9 summarises the findings that life-cycle factors appear more comprehensively influential on the short-term saving ratio than on the long-term saving ratio, and their effects on the short-term saving ratio amongst pension participants, come out, by and large, coherent with those of homeowners. In addition, homeowners with joint income sources appear to save less for the short term and more for the long term. Homeowners with young dependents, in general, put less money away for both the long-term future and short-term purposes.

Table 6.9: Summary of effects of life-cycle factors

	Short-term saving ratio		*Long-term saving ratio*	
	Pension participants	Homeowners	Pension participants	Homeowners
Age	(-)**	(-)***		
Age-square	(+)*	(+)***		
With young dependents	(-)**	(-)***		(-)***
Smaller household size	(-)**[100]	(-)***		
With joint income sources	(-)**	(-)***		(+)***

Note: *** at the 1% significance level, ** at the 5%, and * at the 10%.

In all cases, the corresponding estimated marginal effects on the changes in the possibility of households having a saving ratio and those on the changes in the saving

[100] The significance level is 5% due to the fact that one household size dummy is significant at the 1% significance level and the other is significant at the 10% significance level.

ratio, if households have already been making saving are simultaneously evident. In addition, the effects in the former case generally are of greater magnitude than in the latter case.

6.5 CONCLUSION

In an attempt to examine the effectiveness of the buffer-stock model and the quasi-hyperbolic consumption model in explaining households' saving behaviour, the control variables were comprised of heads of household's perceptions of short-term uncertainty or risk, their ownership of illiquid wealth (housing wealth), their enrolment with a private pension scheme (external commitment mechanism for saving for retirement), their employment status (employed/self-employed), their occupations, their socioeconomic status, and demographic characteristics. A random-effect Tobit model was employed on unbalanced panel data, covering waves 10 ~ 13 of the British Household Panel Survey (BHPS), to investigate changes in the short-term saving ratio and the long-term saving ratio with respect to specified control variables, at the household level. In general, the estimates have shown that differences exist between determinants of long-term saving ratio and those of short-term saving ratio. This indicates that households' savings decisions of a short-term planning horizon are different to those of a long-term planning horizon and this supported the concept of inconsistency between short-term and long-term decisions.

Some evidence is supportive of the quasi-hyperbolic consumption model. Homeowners tended to save less for the short term than non-homeowners at the whole sample level. Two explanations are proposed: firstly, housing wealth provides implicit liquidity, so that households feel it is less necessary to put away money for the short term; secondly, this demonstrates quasi-hyperbolic discounting behaviour in which households tend to possess short-term savings at lower levels and meanwhile engage in illiquid housing wealth. By contrast, homeownership does not affect households' long-term saving ratio, and this highlights the preceding second explanation, in that households are only too impatient to have short-term savings, but are still rational so as to manage long-term discretionary savings. Private pension participants tend to save more for the long term at the whole sample level. This shows that pension participants possess a more profound inclination to save for the long term than their counterparts, and this can be explained in

that pension participants' motive for saving for retirement is enhanced further by their accumulation of pension wealth (Katona, 1965). Moreover, there is no evident substitution effect of pension wealth on the accumulation of financial wealth for long-term purposes. This study considered habit effects on households' intertemporal saving behaviour, as following a routine is more consistent with human nature, suggesting an endowment effect. It was found that households, who save as a result of habit, i.e. for no specific reason, tend to save less for the short term, but save indifferently for the long term to those with a specific purpose for saving. This indicates the possibility that households possess a high discount rate with short-term discretionary saving, or that they practice mental accounting, so that savings for no specific reason are likely to be in an account with a high propensity to consume.

The relationship between the short-term saving ratio and short-term risk is not significant at the whole sample level or in each subgroup, which does not support precautionary saving effect form a short-term perspective. Nevertheless, evidence of precautionary saving behaviour can be found: self-employment households tend to save more for both the long term and the short term, than employees. This is in line with the notion that the self-employed need more liquidity than employees, even though they hold illiquid wealth or pension wealth. Households in the 'sales', 'personal & protective services', and 'craft related' occupations tend to save more for the short term and save less for the long term, than households in the 'plant and machine operative' sector. This can demonstrate precautionary behaviour, because these households save more owing to their having fluctuating income streams. This is also observed in the subgroups of pension participants (only weakly) and homeowners. Finally, households with joint income sources, tend to save less for the short term and more for the long term. This is also evident in the subgroups of homeowners and pension participants.

Females tended to save less for the long term than males at the whole sample level and in the subgroups of pension participants and homeowners. Highly educated households tend to save less for the short term and more for the long term at the whole sample level and in the subgroups of homeowners and pension participants.

Overall, the estimates of the relative magnitudes of the marginal effect on the possibility of households having a positive saving ratio and of that on changes to a saving ratio, if

households were already saving, confirm that the effects in the former cases are of greater magnitude than those in the latter.

CHAPTER 7 : SAVINGS-AGE PROFILE

7.1 INTRODUCTION

This chapter investigates households' savings-age profile over the working life cycle – between ages 25 and 65. In an attempt to understand better the age effects on households' saving behaviour, their total discretionary savings-age structures are investigated, followed by an examination of long-term and short-term savings structures. This study thus has the advantage of breaking down discretionary savings into long-term time and short-term time preferences.

Two sets of theoretical implications will be examined: one is derived from the standard life-cycle model/buffer-stock model, and the other is derived from the behavioural models, i.e. the quasi-hyperbolic consumption life-cycle model and the behavioural life-cycle model. The standard/conventional life-cycle model proposes that the main motivation for saving is to accumulate resources for later expenditure and in particular to support consumption at the habitual standard during retirement. Consumption smoothing leads to a hump-shaped age path of wealth holding (Modigliani, 1986): households' savings are low in young age, increase gradually, reaching a peak during the 50s, and decrease after retirement. This has led to much attention on the testing of this hypothesis, by estimating savings-age profile over the life cycle through empirical observation. The buffer-stock model, based on the life-cycle/permanent income hypothesis, making the assumption that individuals accumulate assets mainly to buffer income uncertainty/risk, suggested that precautionary savings, in terms of financial wealth, exhibited an inverse-V shape over the life cycle. This is consistent with the basic idea of a humped savings-age profile: the allocation of resources over time.

The behavioural models, which incorporate the influences of inconsistent time preferences, as discussed in chapter 2, imply that economic agents would have more savings for long-term purposes than for short-term purposes. Provided that external saving schemes are available, savings for long-term purposes may pick up the life-cycle effects, whereas savings for short-term purposes, including precautionary savings, remain small and constant throughout the life cycle as a result of households' refraining

themselves from saving too much for the short term. Hence, households' long-term and short-term savings patterns throughout the life cycle ought to be investigated separately. This will exhibit the resources that households' allocate over the relevant horizon at a point in time, which is influenced by their inter-temporal time preferences, over the working life cycle (Attanasio and Banks, 2001).

A non-parametric conditional quantile estimation method is applied to four consecutive cross-sectional datasets for the wave 10 to 13 of the BHPS. The estimates are obtained not only at the whole sample level, but also for five subgroups - males, females, homeowners, private pension participants, and employees. One limitation of this work was that it was not able to track households' saving behaviour over time, which could only be done through panel-data analysis. Having said so, time-effects could be detected by comparing four consecutive estimates; however, treatments in order to separate cohort (year of birth) effects from time effects were not applied in this work, as this would require a long panel data. In addition, the savings patterns of households aged over 65 were not investigated because they were not included in the sample[101]; as a consequence, only savings profiles over the working life cycle, between ages 25 and 65, were investigated.

Section 7.2 summaries the econometric model. Section 7.3 analyses savings-age profiles at the whole sample level. Section 7.4 examines the profiles of the aforementioned subgroups. The values of savings amount (£/year) are at the price level of September 2000. Section 7.5 concludes this chapter.

7.2 REVIEW OF METHODOLOGY

The empirical framework is illustrated in a univariate function,

$Savings_i^T = f(age_i)$, where $Saving_i^T$ denotes a household's total savings,

$Savings_i^{LT} = f(age_i)$, where $Saving_i^{LT}$ denotes its long-term savings, and

$Savings_i^{ST} = f(age_i)$, where $Saving_i^{ST}$ denotes its imputed short-term savings.

[101] This is mainly to keep the consistency of samples over the three empirical works of this study.

i denotes households. Total savings are specified as the subjectively reported amount of money that individuals put away within the last year in which each wave of British Household Panel Survey (BHPS) was carried out. Bills, regular expenses, and regular endowments, such as mortgages, are presumed to have been paid before individuals put away the money. Long-term savings and short-term savings are measured in advance, and this was addressed in chapter 3. A non-parametric kernel-smoothed conditional quantile estimation method, developed by Magee, Burbidge, and Robb (1991), is employed to accomplish the estimation.

The basic algorithm is presented below. In the following, α represents the quantile of the distribution of Y given $X = x$ as $q_\alpha(x)$, which solves

$$F(q_\alpha(x)|x) = \alpha, \qquad (1)$$

Where $F(y|x)$ is the conditional cumulative distribution function (cdf) of Y given x evaluated at $Y = y$. An estimate $\hat{q}_\alpha(x)$ can be obtained from the observed pairs (X_i, Y_i) $(i = 1,...,n)$ by solving (1) after replacing F with some estimate $\hat{F}$. One choice of $\hat{F}$, which smoothes over X, is

$$\hat{F}(y|x) = \sum_i K\{(X_i - x)/h\} I[Y_i \le y] \Big/ \sum_i K\{(X_i - x)/h\},$$

Where K is a kernel function and I is the indicator function: $I[A] = 1$ if A is true, $I[A] = 0$ otherwise. In order to choose the bandwidth parameter h, a leave-one-out cross-validation (CV) approach is used in which h is chosen to *minimise the loss function*:

$$L(h) = \sum_i r_\alpha(Y_i - \hat{q}_\alpha^{(i)}(X_i)),$$

Where $r_\alpha(z) = |\alpha - I[z < 0]|$. $|z|$ is the leave-one-out loss function employed and $\hat{q}_\alpha^{(i)}$ denotes the estimate of $q_\alpha(X_i)$ using bandwidth h, where observation i has been dropped from the sample.

The cross-validation approach is a non-parametric estimation of statistical error, mainly the bias and standard error of an estimator. It is a way of obtaining nearly unbiased estimators of prediction error. The method deletes the observations X_i from the data set *one at a time*, and recalculates the prediction rule on the basis of the leave-

one-out sample. It shows how well the recalculated rule predicts the deleted observation, and takes the averages of these predictions calculated by deleting one observation at a time. (Efron and Gong, 1983)

Under the empirical framework of this study, Y_i denotes either the measured short-term savings or the measured long-term savings of each household, and X_i denotes the age of the head of each household. $\alpha = 0.25,0.5,0.75$. Kernel smoothing involved a kernel function, $f(x-a)$, which gives the weight to be attached to observations at age x in the estimation of age a. Two aspects of the kernel should be chosen by investigators: the bandwidth and the shape. Please see section 4.4 regarding more details.

7.3 EMPIRICAL ANALYSIS AND RESULTS – AT THE WHOLE SAMPLE LEVEL

7.3.1 Total savings-age profile

Figure 7-1 exhibits four households' total savings profiles, by plotting saving amounts against age cohorts, at the median level, each representing one wave. In wave 10, total savings go upwards between ages 25 and 32, descends over the 30s, increase from age 39 onwards, reach a peak level in the mid 40s, and remain steady until age 65. In wave 11, the profile in general is similar to that observed in wave 10, except that total savings start to descend from a peak level in the late 50s and decrease continually during the 60s. In wave 12, total savings rise throughout the 20s and 30s, reach a peak at around age 40, and stay at this peak level for rest of the working life cycle. In wave 13, total savings grow from age 25 onwards, reach a peak level around age 30, remain steady at the peak level until age 60, and descend from then onwards.

In all four waves, total savings remain stable at peak levels throughout middle-age – between the mid 40s and late 50s; prior to this, total savings are located at a low level in the mid 20s, increase gradually during the 20s, 30s, and early 40s. I propose that this upward trend could mainly reflect income growth over the life cycle, as well as other life-cycle effects, such as increase in family size. After the late 50s, the total savings

profiles in the different waves exhibit ambiguities: staying at the peak level until age 65 in waves 10 and 12 and descending steadily in waves 11 and 13. Only the profile of wave 11 displays a humped shape, as it shows that households' savings are at their lowest level during young age, rise and reach a peak level in middle-age, and continually descend during ages close to retirement. However as described previously, the estimated profiles of the four waves do not, in general, appear humped. In comparison, Demery and Duck (2006) used a parametric approach to examine the saving ratio-age profile on the UK Family Expenditure Survey (FES) dataset over the years 1969-1998, and found that the estimated profile exhibited a hump between age 25 and 65.

The findings here confirm that savings are at a peak level in the late 40s and throughout the 50s, and this is in line with some of the previous literature on savings-age profile (Alessie, Lusardi, and Aldershof, 1997; Attanasio, 1998). This is consistent with the standard/conventional life-cycle hypothesis.

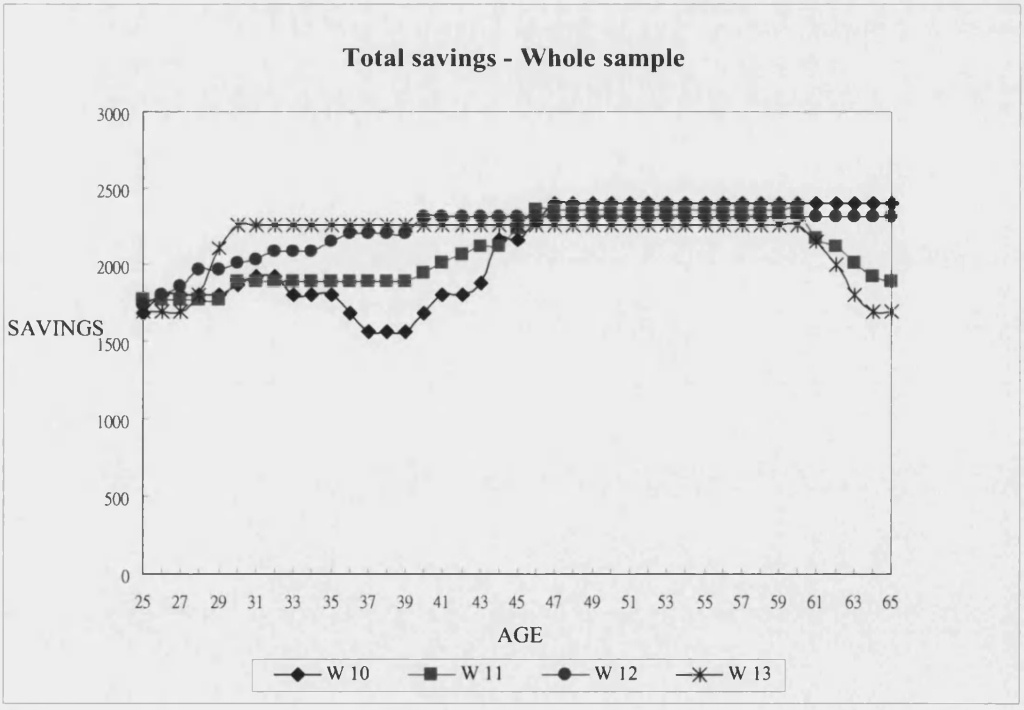

Figure 7-1: The total savings-age profiles of the whole sample

7.3.2 Long-term savings and short-term savings-age profiles

Four cross-sectional estimates of long-term saving-age profiles are displayed in Figure 7-2. In wave 10, long-term savings are at the lowest level at age 25, move upwards during the 20s, 30s, and 40s with occasional fluctuations, reach a peak around the late 40s, and stay at this peak level during the 50s and 60s. The profiles of waves 11, 12, and 13 are similar to that of wave 10, but long-term savings in waves 11 and 13 achieve their peaks in the mid 40s and those in wave 12 at age 41. A general trend is observed: savings of the young cohorts are the lowest, and they move upwards during the late 20s, 30s, and early 40s. After age 45, long-term savings remain stable at peak levels until age 65.

Long-term savings observed above show a similar pattern. This indicates that long-term savings tend to grow with increases in income, as the permanent income hypothesis suggests that the average permanent income of the young cohorts starts at its lowest point just as they enter the labour market, and income gradually increases and reaches a peak in the middle-age phase. In addition, one particular life-cycle factor, family size, can have an influence on the long-term savings amount; for instance, heads of household in middle-age are likely to have young children, older dependents, or both, who can be financially demanding in the long run.

Long-term savings become stable after the mid 40s. Regarding this, several points are addressed here. First, long-term savings do not decrease close to retirement age. There are several possible reasons for this: 1) bequeathing to the next generation is one of them; 2) it reflects the decline in total expenditure as the number of dependents is decreasing; 3) it can refer to that households save regarding their expectancy of mortality risk, and as suggested in Jappelli (2005) that, such savings for mortality risk may become unintentional bequests. Second, the steady trend suggests that households tend to make a particular amount of savings for future requirements, even though income possibly still increases during this period. This can indicate that households at this life stage save by committing themselves to saving schemes, which regularly takes a certain amount of money from their monthly income; alternatively, there is the possibility that households follow an internal rule, which binds them to regularly saving a certain amount of money. The roles of internal rules or external saving

commitments illustrate different approaches for households to tackle self-control problems, as suggested in the behavioural models.

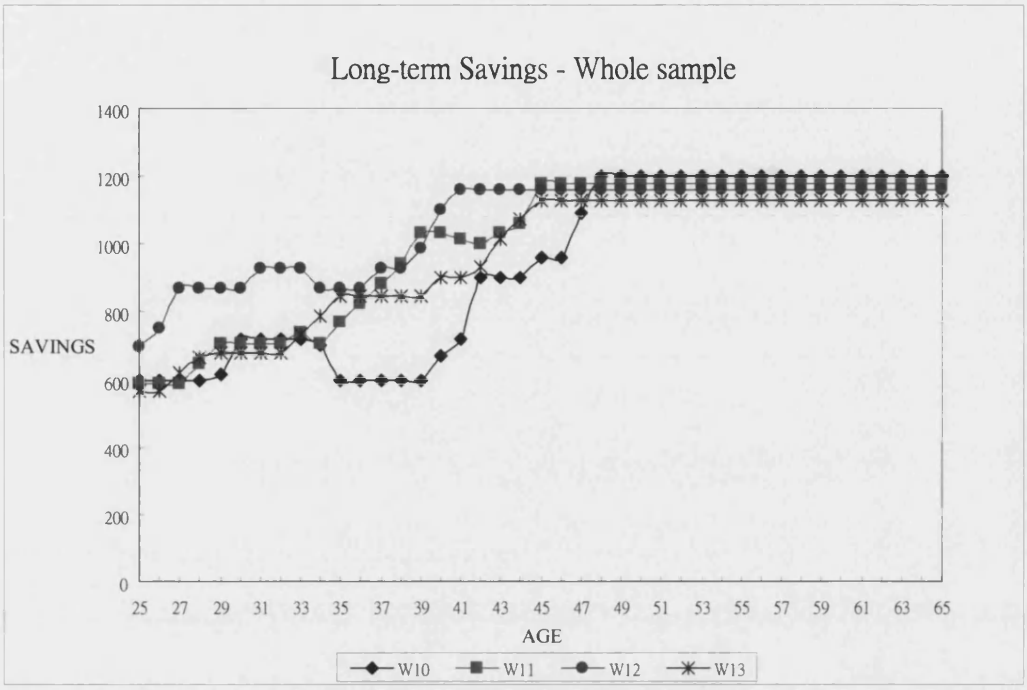

Figure 7-2: The long-term savings-age profiles of the whole sample

Four cross-sectional estimates on short-term savings-age profiles are displayed in Figure 7-3. In wave 10, short-term savings are at high levels over the late 20s and over the 40s, and stay relatively low throughout the 30s, 50s and early 60s. In wave 11, short-term savings remain stable between ages 25 and 57, drop slightly between ages 57 and 61, and rise after age 61. In wave 12, short-term savings start at a peak level at age 25, drop slightly during late 20s, remain stable through the 30s, 40s, and 50s, and descend markedly in the 60s. In wave 13, short-term savings go up a little during the 20s, become stable at a high level, and decline after age 55.

In general, short-term savings levels remain steady between age 25 and the mid 50s, and after that, savings noticeably fall. This steady trend before the mid 50s shows that households accumulate only a limited amount of money and life-cycle effects discussed earlier have little influence on them. This supports the possibility that households are reluctant to save for the short term, as they tend to constrain themselves from splurging by saving only a limited amount money for short-term future, such as

for buffering high-frequency income fluctuations (Laibson, 1998; Carroll, Dynan, and Krane, 2003). The preceding explanation is related to households' high time preference (high discount rate) with regard to saving for the short term. Samwick (1998) simulated the wealth-to-income ratio of households who were assumed to have a constant *high discount rate* over the life cycle, and obtained a profile showing that the wealth-to-income ratio[102] remained constant between ages 25 and 55. The finding in this work thus reinforces Samwick's (1998), by suggesting that households' estimated short-term savings profiles reflect a high time preference, and this is consistent with the quasi-hyperbolic consumption model.

Apart from wave 11, it is generally observed amongst the other three waves that a drop in short-term savings takes place between ages 50 and 60, in particular in waves 12 and 13. The drop can be attributed to two reasons. First, the degree of exposure to income risk, particularly unemployment risk, is at its lowest when households are close to retirement age, and thus households accumulate less precautionary savings for the short term. Moreover, these households are generally of smaller size; therefore, they make fewer savings for regular expenses in the future. It is in waves 12 and 13 that short-term savings fall profoundly in the ages prior to retirement.

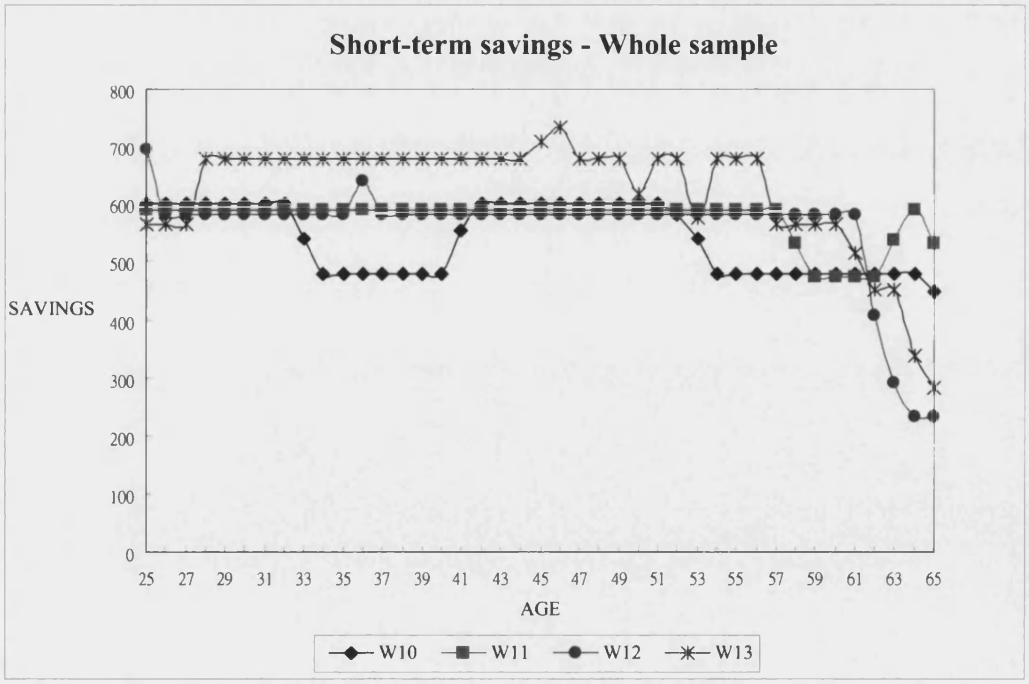

Figure 7-3: The short-term savings-age profiles of the whole sample

[102] The wealth takes into account of savings both for precautionary motives and for retirement.

7.3.3 Summary

Contrasting the long-term savings profile for each wave with short-term profile confirms that households, in general, save more for the long term than for the short term, in that the estimated medians of long-term savings are above those of short-term savings, throughout the working life cycle. This supports one implication of the quasi-hyperbolic life-cycle consumption model: households prefer saving more for the long-term future than saving for the short term. In sum, the estimated long-term profiles are consistent with the implication of a standard/conventional life cycle model and short-term savings-age profiles suggest that households have higher time preference with saving for the short term. These two findings are in support of the behavioural models which suggest that households have inconsistent time preferences with saving for a long-term horizon and for that of short term.

Comparing Figure 7-2, and Figure 7-3, it is seen that the upward trend of total savings is highly determined by long-term savings, whereas the downward tendency close to retirement age, if present, is due to decreasing short-term savings, but long-term savings remain constant during that period. This can be explained as that these households keep making long-term savings as a result of longer life expectancy or an intention of bequeathing to the next generation. On the other hand, they save less for the short term because they expect less unemployment risk when they approach retirement.

In general, differentials are observed amongst the profiles of the four waves. This may be due to the unbalanced panel dataset used in this study. As can be seen in Table 7.1, only 13.5% of the households appeared in every wave and more than 40% of them are present only in one wave. This means the effects of household heterogeneity cannot be completely ruled out. Furthermore, a time effect can be another explanation for the differentials.

Table 7.1: The number and percentage of households presenting in four, three, two, and one wave, respectively – At the whole sample level

	In four waves		**In three waves**		**In two waves**		**In one wave**		**Total**	
	Number	%	Number	%	Number	%	Number	%	Number	%
Whole sample	480	13.5	654	18.4	888	24.9	1539	43.2	3561	100

7.4 EMPIRICAL ANALYSIS AND RESULTS – AT SUBSAMPLE LEVEL

The savings-age profiles of the subgroups – males, females, homeowners, private pension participants, and employees – will be investigated below. It has been found in the preceding two chapters that gender difference leads to variations in saving preferences, and as a consequence, the savings-age profiles of females and males are separately estimated. Homeownership is considered as a proxy indicator for the possession of housing (illiquid) wealth, and estimating the savings-age structures of homeowners aims to investigate how households, whilst possessing illiquid assets, discretionarily accumulate financial wealth for the short term and the long term. Households who have joined a private pension scheme are considered to have been committing themselves to external devices, so as to postpone current consumption and to save for retirement. Given that the self-employed exhibit different saving patterns from employees, the savings-age profiles of employees are estimated by leaving out the effects of the self-employed[103].

7.4.1 Males

7.4.1.1 Total savings-age profile

Figure 7-4 shows the four total savings profiles for males, each representing one wave. In wave 10, total savings have an upward trend throughout the working life cycle: they are at their lowest level at age 25, move up and then fall during the 30s, and increase again through the 40s, 50s, and 60s. In the other three waves, the profiles appear virtually flat throughout the life cycle, and it is only in wave 11 that a small hump comes into view during the 50s.

It is observed amongst the four waves that males' total savings are at relatively high levels during their 50s, and this is analogous to what has been observed amongst the whole sample. Life-cycle effects in terms of income growth and increase in family size

[103] Difficulties occurred in estimating the self-employeds' savings-age profiles as their sample size was too small.

appear to be rather weak on males' total savings-age structure, as only the profile in wave 10 exhibits an upward trend during the 30s and 40s; in addition, total savings do not appear to decrease close to retirement age.

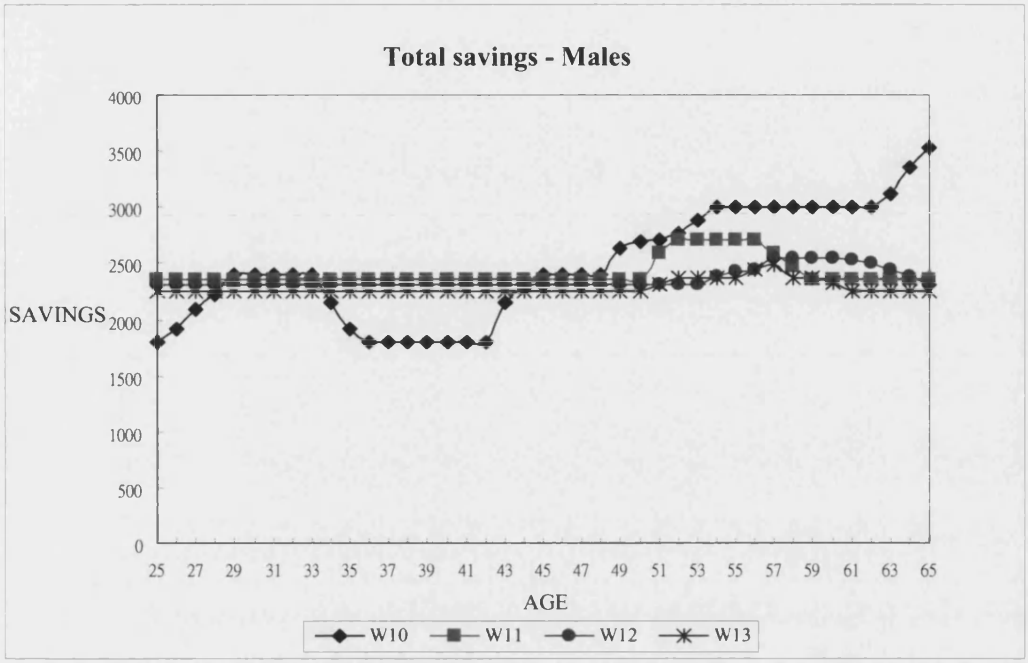

Figure 7-4: The total savings-age profiles of males

7.4.1.2 Long-term and short-term savings-age profiles

Figure 7-5 shows four cross-sectional long-term savings profiles of males. In wave 10, long-term savings constantly increase throughout the working life cycle: exhibiting the lowest level at age 25, a tremendous growth between ages 35 and 58, and remaining stable here. In wave 11, the profile shows an upward trend between ages 25 and 32, stays stable between ages 32 and 48, is illustrated by a hump during the late 40s and 50s, and becomes stable again in the 60s. In wave 12, the profile shows an increase between ages 25 and 27, remains flat afterwards until age 50, and grows again between ages 50 and 65. In wave 13, the profile is similar to that in wave 11, but there is a smaller hump between ages 53 and 60.

Briefly, there are two periods in which males are more active in saving for the long term, than at other times during the working life cycle, in terms of upward trends shown in the estimated long-term savings profiles. One spell is in late 20s until the early 30s: during this period, males could be saving mainly for the long term, in order to buy a property in

the future or saving for plans in their approaching 30s, for example, starting a family. The other spell is in the 50s: in this period, household income usually reaches its highest level during working life; in addition, family expenditure is decreasing, because the numbers of dependents are usually low in households aged over 50. With more money left after regular expenditure, households make more savings for long-term purposes.

In sum, long-term savings-age profile of males exhibited some evidence in support of the conventional life-cycle hypothesis. First, the profiles of waves 11 and 13 display themselves to be humped during age 50s. Second, the savings reach the peak levels in mid-50s in waves 10, 11, and 13. Thirdly, upward trends can be seen during young age and middle age in the four waves.

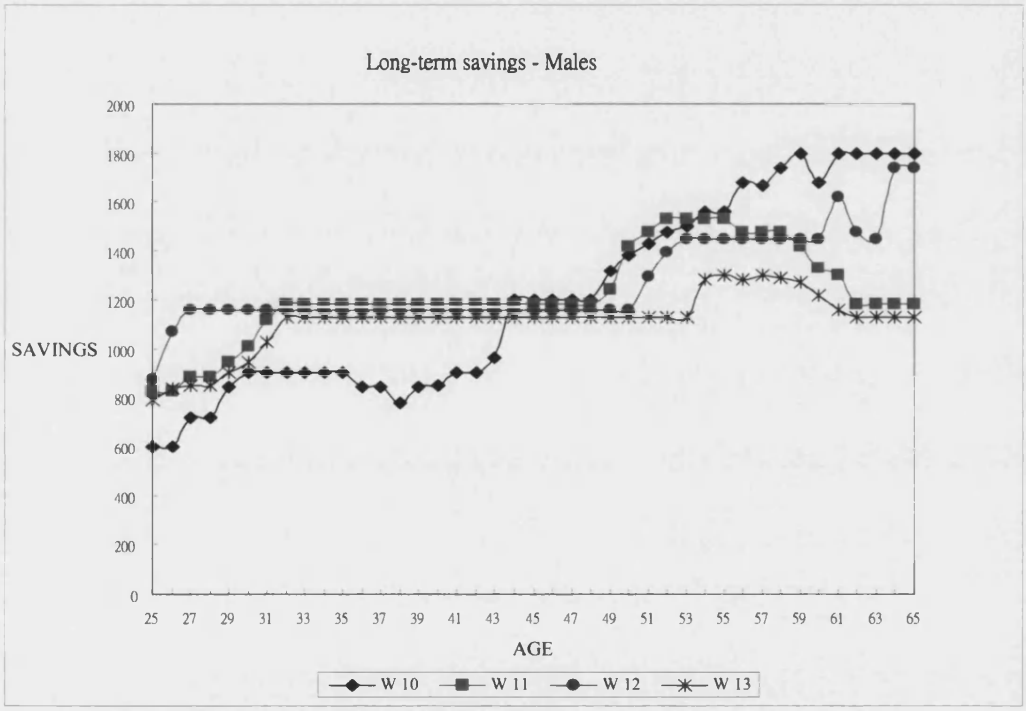

Figure 7-5: The long-term savings-age profiles of males

Figure 7-6 shows short-term savings profiles. In waves 10 and 11, short-term savings are at their highest level at age 25, decrease slightly by age 27, become steady between age 27 and the mid 50s, and fall again thereafter, reaching their lowest level at age 65. In wave 12, short-term savings are situated at a high level at age 25, decrease between ages 25 and 30, subsequently become steady until age 62, with several humps during this period, and drop afterwards until reaching the lowest level at age 65. In wave 13,

short-term savings increase slightly between ages 25 and 29, fluctuate to a limited extent between ages 29 and 58, and then descend sharply, reaching their lowest level at age 65.

Apart from the estimates in wave 13, the estimates confirm that the short-term savings of the young cohorts in their late 20s are at their highest, when considering the whole working life cycle. This reflects the notion that young people tend to have more precautionary (short-term) savings. It is observed across the four waves that short-term savings remain stable during the 30s, 40s, and 50. A constant level of short-term savings throughout these age groups supports the possibility that males possess a high time preference with saving for the short term, which keeps the levels of savings constantly low. This is evidence in support of the behavioural models. It can also be seen that life-cycle effects, which would make the savings profiles humped, do not appear evident on short-term savings profiles.

Eventually, a fall occurs around the late 50s, and short-term savings are descending during the 60s, reaching their lowest level by the end of the working life. This strongly indicates that males save less for the short term, whilst they are approaching retirement, and this can be as a result of decreasing income risk in that age phase. This is consistent with the prediction of the standard life-cycle model.

Disparities between the short-term savings of wave 13 and those of the other three waves are observed; this is considered to be caused by a specific time-effect, e.g. macroeconomic shock, which occurred during the interviewing period.

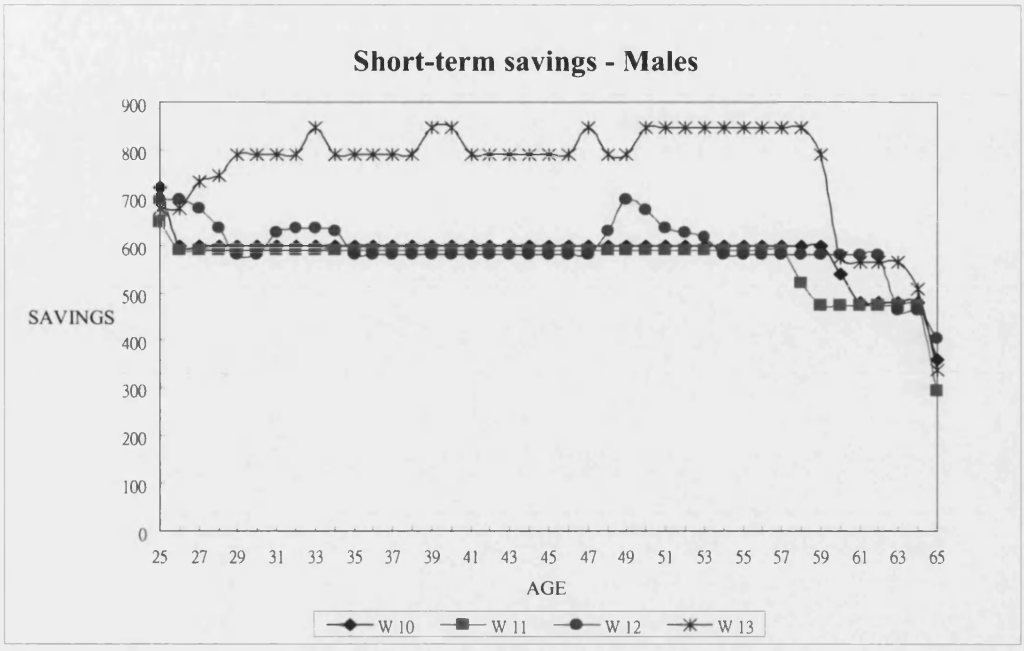

Figure 7-6: The short-term savings-age profiles of males

7.4.1.3 Summary

Contrasting Figure 7-5 with Figure 7-6 shows that the long-term savings profiles of males are located well above the short-term savings profiles throughout the working life cycle. This shows that males prefer saving for the long term to for the short term. In addition, discrepancies between two types of savings-age profiles suggest the existence of inconsistent time preferences with males' savings decisions for the long term and for the short term. In sum, there is evidence in support of the behavioural models: the long-term savings-age profiles are more consistent with the standard/conventional life-cycle model, whereas short-term profiles suggest that households have the tendency to keep the levels of savings constantly low, indicating the possibility that males have high time preference towards saving for the short term.

Males' total savings-age profiles are flattened by both long-term savings and short-term savings. The upward trends that occur across young ages amongst the long-term savings profiles do not appear amongst the aggregate savings profiles, as these effects are disguised by the flat trends observed in the short-term savings profiles. In comparison to those in the long-term savings profiles, the humps appear moderate in the aggregate savings profiles, as they are mitigated by the flat trends observed in the short-term

profiles. Finally, the decreasing trends observed amongst short-term profiles do not appear in the aggregate profiles. This indicates that, during ages close to retirement, males save less for the short term but not necessarily save less for the long term.

As shown in Table 7.2, only 15.3% of the total household appear in four waves, and over half of them appear in one or two waves. In addition to time effects, this may also contribute to the disparities observed in the profiles of different waves.

Table 7.2: The number and percentage of households presenting in four, three, two, and one wave, respectively – Males

	In four waves		In three waves		In two waves		In one wave		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Males	408	15.3	514	19.3	677	25.4	1063	39.9	2662	100

7.4.2 Females

7.4.2.1 Total savings-age profile

Figure 7-7 exhibits four female total savings profiles against age cohorts, each representing one wave. In wave 10, total savings remain constant over the whole working life cycle. In wave 11, the curve for total savings appears stable between ages 25 and 41, exhibits a hump between ages 41 and 51, and becomes stable again during the 50s and 60s. In wave 12, the profile appears similar to that of wave 11, and the hump occurs between ages 44 and 57. In wave 13, the curve of total savings stays constant between ages 25 and 43, shows a hump between ages 44 and 53, which is flatter than those in waves 11 and 12, becomes flat between ages 53 and 59, and finally descends between ages 59 and 65.

In general, females' total savings remain flat throughout the 20s and 30s, appear as a humped curve between the 40s and mid 50s, and then become steady until the end of the working life cycle. Amongst the four cross-sectional estimates, it is only observed in wave 13 that total savings are at the lowest level in ages close to retirement. Females' total savings achieve peak levels in the late 40s, which is an earlier age than that observed amongst males.

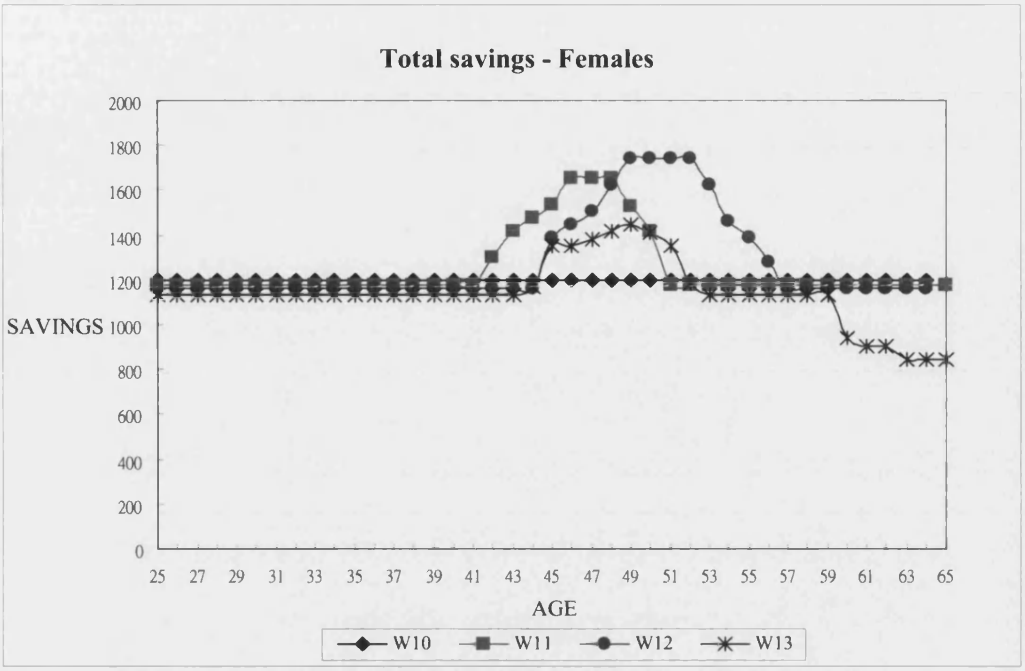

Figure 7-7: The total savings-age profiles of females

7.4.2.2 Long-term and short-term savings-age profiles

Figure 7-8 shows four cross-sectional long-term savings profiles. In wave 10, the curve of long-term savings is located at a relatively high level at age 25, shows a downward trend between ages 25 and 30, becomes stable at a low level during the 30s, increases considerably throughout the 40s, becomes stable again at the peak level between ages 48 and 55, and descends significantly thereafter, reaching the lowest level at the end of the working life cycle. In wave 11, the curve of total savings remains at its lowest level during the 20s, ascends significantly in the 30s until achieving its peak, becomes stable thereafter throughout the 40s and 50s, and slightly decreases during the 60s. In wave 12, the curve of total savings appears stable, at its lowest level, between ages 25 and 34, goes up between ages 34 and 42, until reaching its peak, and becomes constant throughout the rest of the working life cycle. In wave 13, the long-term savings profile stays constant at a low level between ages 25 and 32, goes up between ages 32 and 46, until reaching its peak, becomes stable at the peak level between ages 46 and 57, decreases considerably during the late 50s, and stabilises again in the 60s.

The profiles of waves 10, 11, and 13 are all humped between the 30s and 50s, showing increasing long-term savings in the 30s and early 40s and decreasing long-term savings during the late 50s, which is the period close to retirement.

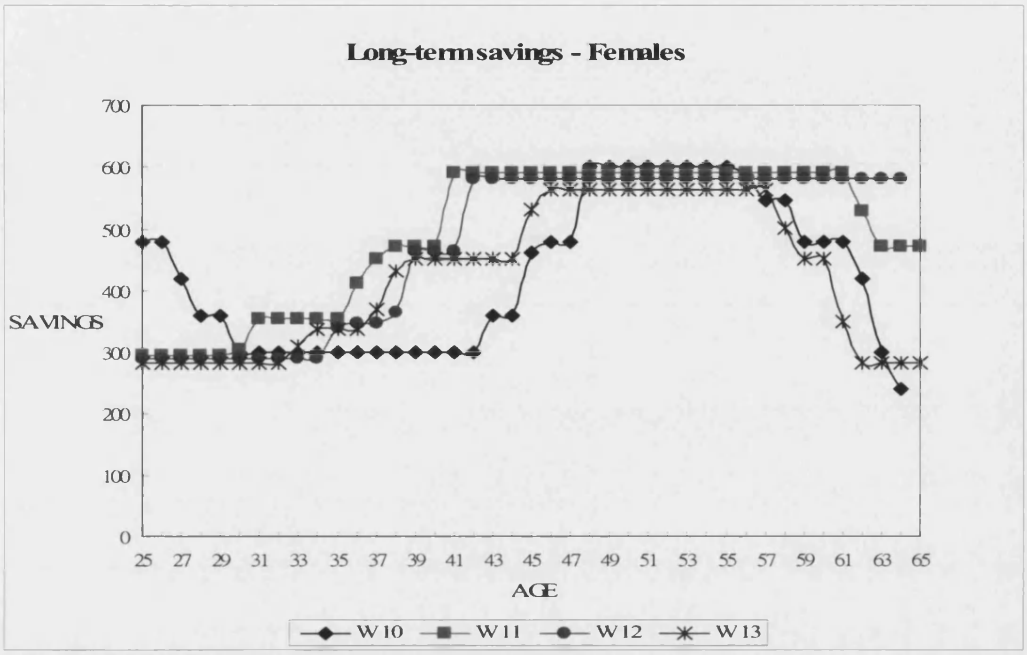

Figure 7-8: The long-term savings-age profiles of females

Figure 7-9 exhibits the short-term savings profiles for females. In wave 10, the curve of short-term savings remains constant between ages 25 and 37, grows slightly between ages 37 and 41, becomes stable at a relative high level between ages 41 and 49, decreases to its lowest level during the 50s, and increases significantly in the 60s. In wave 11, the profile remains constant at a high level throughout the 20s and 30s, descends slightly between ages 39 and 41, becomes stable between ages 41 and 48, exhibits another drop between ages 48 and 52, until reaching its lowest level, remains steady at this level during the 50s, and climbs up significantly for the rest of the working life cycle. In wave 12, the curve of short-term savings remains stable throughout the 20s, 30s, and 40s, shows a small drop between ages 50 and 52, and becomes stable again in the 50s and 60s with a drop and a bounce back occurring in the early 60s. In wave 13, the profile remains constant at its peak level throughout the 20s, 30s, and 40s, descends gradually during the 50s until achieving its lowest level, and becomes stable during the 60s.

Some common patterns can be observed. Short-term savings appear stable at peak levels, if not, a relatively high level, during the 20s, 30s, and even the 40s. Savings decrease constantly throughout the 50s and generally are found to be at the lowest levels. In ages close to retirement, short-term savings rise in waves 10, 11, and 12, and this suggests the possibility that females' precautionary saving motives are enhancing.

These profiles do not exhibit pronounced evidence in support of the behavioural models. To begin with, savings are not kept at a constantly low level over the working life. Secondly, as analysed in the previous paragraph, the patterns of these profiles may suggest the existence of precautionary saving behaviour. Meanwhile, these profiles did not display themselves to be humped, which does not support the standard life-cycle model.

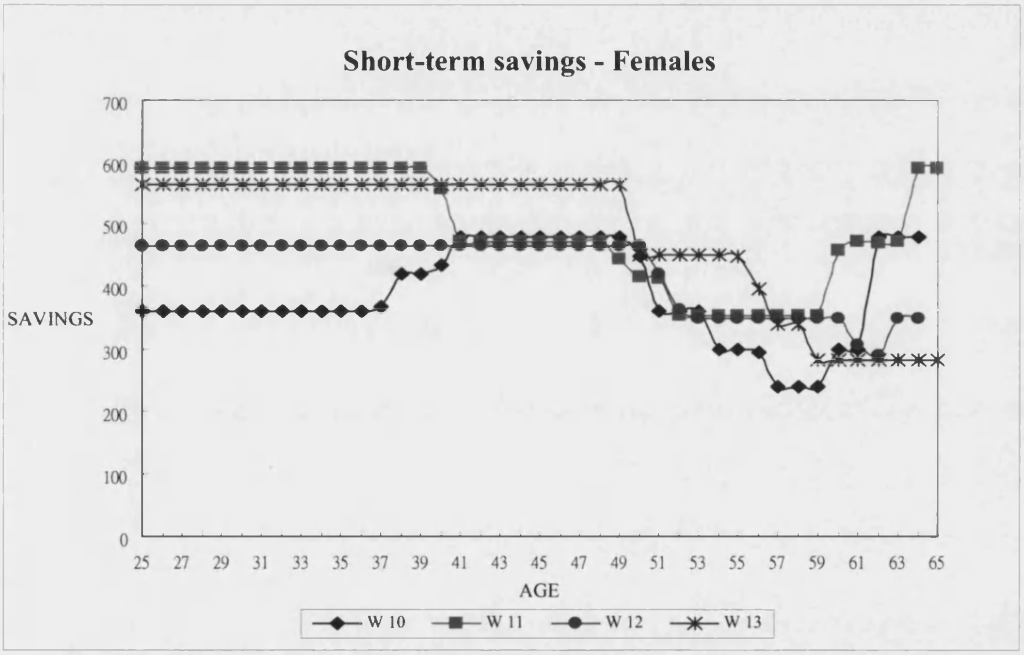

Figure 7-9: The short-term savings-age profiles of females

7.4.2.3 Summary

Contrasting Figure 7-8 with Figure 7-9 shows that females save more for the short term, than for the long term, before middle age: the short-term savings curve is above that of the long term from the 30s to the 60s, in wave 10, during the 20s and 30s in wave 11, through the 20s, 30s, and 40s in wave 12, and in the period up until age 45 in wave 13. This suggests that females do not always prefer saving for the long term across the

working life cycle, thus this goes somewhat against the quasi-hyperbolic consumption model. The humps observed in females' total savings profiles are mainly attributed to long-term savings patterns that can be described by the standard/conventional life-cycle model.

Females tend to save less for the long term and more for the short term in the last few years of their working lives, whereas equivalent males tend to save as much as their middle-age cohorts and moreover save more for the long term and less for the short term. Possible explanations for this are as follows. First, it suggests that males have a stronger bequest motive than females, thus males are keener to leave wealth for the next generation by saving more for the long term. Second, it has been suggested that, in general, old households may have more precautionary savings in that they are more risk averse than young households (Borsch-Supan, 1992). This provides an explanation for females' savings profiles, but not for those of males.

As seen in the figures, disparities are observed amongst the profiles of different waves. This can be explained by: 1) the sample size of females are relatively small; 2) as can be seen in Table 7.3, more than 50% of the female households appear only in one wave but only 8% of them present in four waves, so individual heterogeneities cannot be controlled properly; and 3) time effects exist.

Table 7.3: The number and percentage of households presenting in four, three, two, and one wave, respectively – Females

	In four waves		In three waves		In two waves		In one wave		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Females	72	8	140	15.6	211	23.5	476	52.9	899	100

7.4.3 Homeowners

7.4.3.1 Total savings-age profile

Figure 7-10 exhibits four homeowners' total savings profiles, by plotting savings amount against age cohorts, each representing one wave. In wave 10, the curve of total savings is located at a relatively low level at age 25, goes up slightly between ages 25 and 32, falls between ages 32 and 35 to its lowest level, becomes stable from ages 35 to

42, exhibits a upward trend between ages 42 and 46, stabilises at a relatively high level during the late 40s, 50s, and early 60s, and shows an increase between ages 63 and 65. In wave 11, the profile is a smooth upward slope during the 20s and 30s until reaching its peak at age 44 and becomes stable, at the peak level, for the rest of the working life. In wave 12, the curve of total savings is located at its lowest level at age 25, shows a smooth ascending trend between ages 25 and 32, reaching its peak, and becomes stable throughout the rest of the working life cycle. In wave 13, the profile shows a small jump between ages 25 and 27, becomes constant at its peak level throughout the 30s, 40s, and 50s, and descends in the 60s.

Homeowners' total savings structures appear relatively flat for the whole working life cycle, and fluctuate within a small margin. In general, the life-cycle effects are not pronounced.

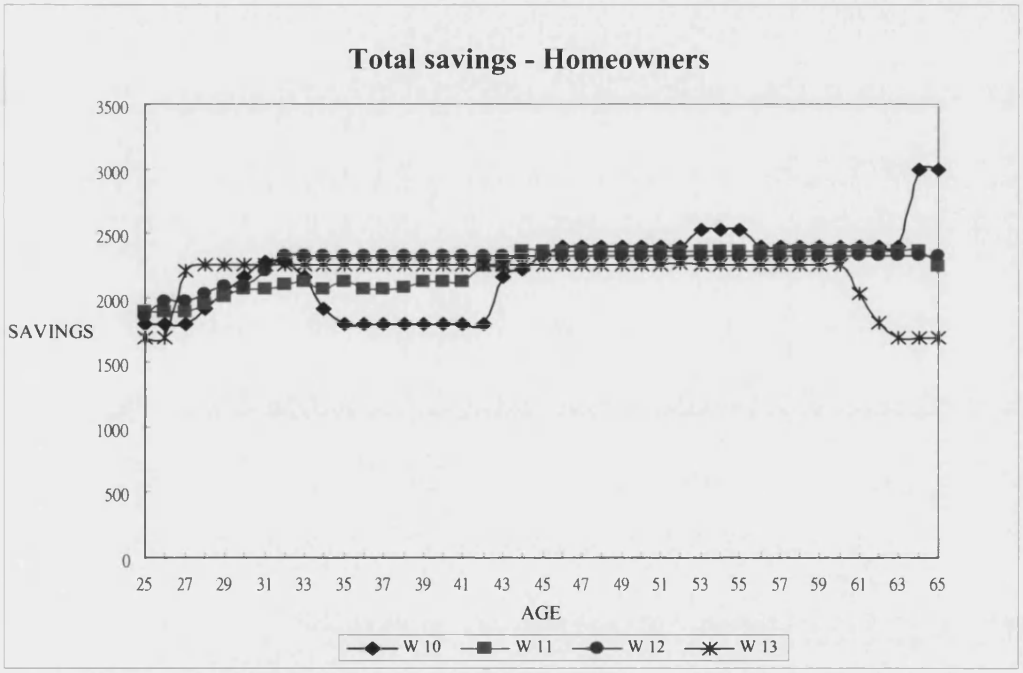

Figure 7-10: The total savings-age profiles of homeowners

7.4.3.2 Long-term and short-term savings-age profiles

Figure 7-11 shows four cross-sectional long-term savings profiles over the life cycle. In wave 10, the curve of long-term savings is located at its lowest level at age 25, shows an upward trend from the 20s to the mid 40s, achieving a relative high level at age 45, becomes stable between ages 45 and 52, exhibits a small hump during the 50s, and

remains stable in the 60s. In wave 11, the profile ascends between ages 25 and 39, reaching a peak, and remains stable thereafter throughout the rest of the working life cycle. In wave 12, the curve of long-term savings ascends significantly between ages 25 and 31, exhibits a downward then upward trend in the 30s, remains stable during the 40s at a relatively high level, shows a small hump in the 50s, and becomes stable during the 60s. In wave 13, the profile is located at its lowest level at age 25, exhibits an upward trend between ages 25 and 41, achieving its peak, and becomes stable throughout the 40s, 50s, and 60s.

Long-term savings increase with up-and-down fluctuations before the middle-age phase, and remain stable thereafter. The estimates for wave 10 and wave 12 both show a small hump during the 50s. The ascending trends during the 20s, 30s, and early 40s, together with the achievement of peak levels in the mid 50s can, to a large extent, be attributed to life-cycle effects, i.e. income growth and an increase in family size. However, homeowners do not reduce their long-term savings whilst approaching retirement.

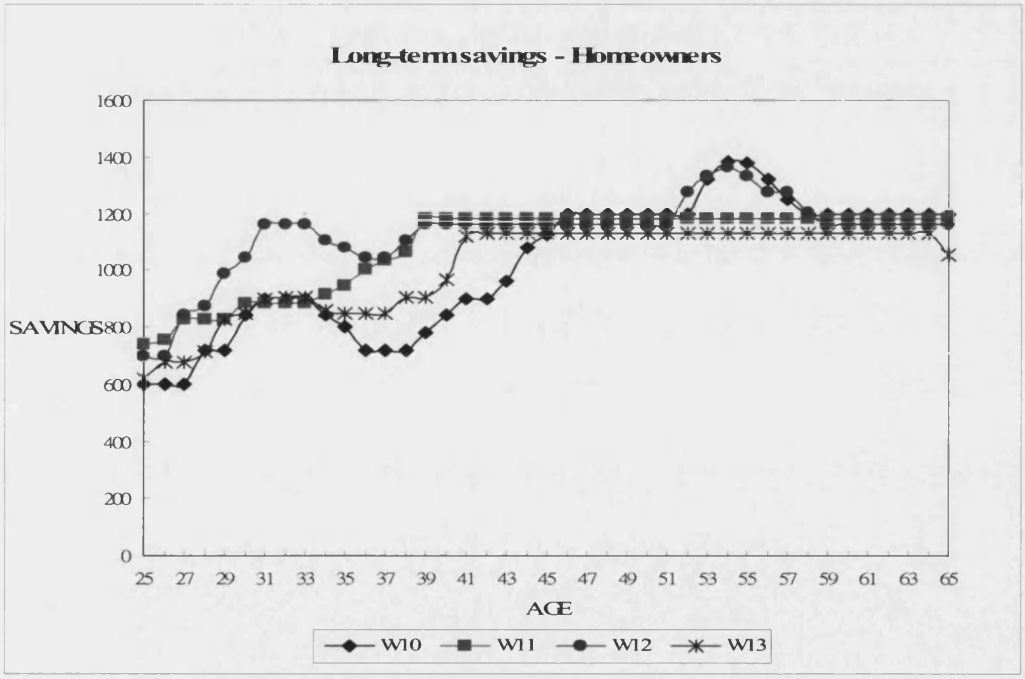

Figure 7-11: The long-term savings-age profiles of homeowners

Figure 7-12 shows four cross-sectional short-term savings profiles over the life cycle. In wave 10, the curve of short-term savings appears stable at its peak level, between the 20s and early 50s, exhibits a downward trend between ages 54 and 57, and becomes

stable thereafter at its lowest level. In wave 11, the curve of short-term savings is located at its peak level at age 25, shows a drop between ages 25 and 27, becomes stable between the 30s and the mid 50s, shows a drop from ages 57 and 59, and generally stabilises for rest of the working life cycle. In wave 12, the profile has its peak level at age 25, slightly descends between ages 25 and 28, becomes stable throughout the 30s, 40s, 50s, and early 60s, and shows a steep drop between ages 62 and 65. In wave 13, the profile is significantly inconsistent with the profiles of the other waves, between ages 25 and 56: it exhibits a constant trend with two humps – ups and downs - between ages 25 and 36 and between ages 43 and 49, and descends after age 56, until the end of the working life cycle.

Amongst the four cross-sectional estimates, short-term savings are, in general, at peak levels in the late 20s (beginning of the working life-cycle), and remain constant during the 30s, 40s, and even the early 50s. Subsequently, savings start to decrease and reach their lowest level in the late 50s or 60s (end of the working life cycle). The divergences observed in wave 13 show higher estimated savings levels including two humps, which are considered as a consequence of the time effects. The observed stabilities between the 30s and the 50s are in support of the behavioural models: savings remain constantly low and are not influenced by life-cycle effects.

It is observed in waves 11, 12, and 13 that homeowners decrease savings for short term purposes during ages close to retirement, and this can be explained by the standard conventional life-cycle hypothesis.

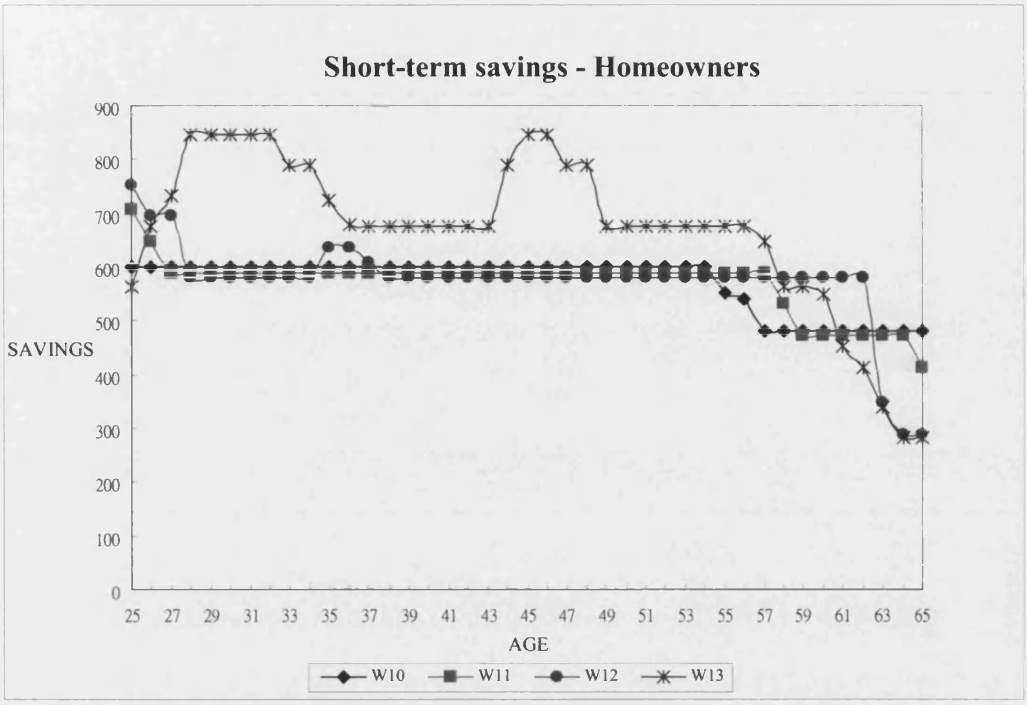

Figure 7-12: The short-term savings-age profiles of homeowners

7.4.3.3 Summary

Contrasting Figure 7-11 with Figure 7-12 shows that homeowners, in general, save more for the long term than for the short term as long-term savings profiles are well above short-term profiles throughout the working life cycle. In sum, apart from the finding that homeowners do not reduce long-term savings when approaching retirement, their long-term savings profiles exhibit strong evidence in support of life-cycle model. In addition, their short-term savings profiles during young and middle age suggest their possessing high time preference towards saving for the short term. These are evidence in support of the quasi-hyperbolic consumption model.

In comparison with the total savings profile of the whole sample, homeowners' profiles are smoother. The life-cycle effects observed amongst homeowners' long-term savings profiles appear to be concealed in the total-savings profiles. The descending trends displayed in the homeowners' short-term savings profiles do not emerge amongst the total saving profiles.

In addition to time effects, the unbalanced dataset (see Table 7.4) can explain the differentials shown in the profiles of different waves.

Table 7.4: The number and percentage of households presenting in four, three, two, and one wave, respectively – Homeowners

	In four waves		In three waves		In two waves		In one wave		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Homeowners	439	14.7	578	19.4	755	25.4	1205	40.5	2977	100

7.4.4 Private pension participants

7.4.4.1 Total savings-age profile

Figure 7-13 shows total savings-age structures of households who have paid into a private pension scheme to save for retirement. In wave 10, the curve of total savings exhibits several ups and downs during the working life cycle: between ages 25 and 40, total savings go up, remain constant, and then smoothly decrease; between ages 40 and 60 total savings increase, become stable until the mid 50s, and show a drop in the late 50s; beyond age 60 total savings show an upward trend and reach their peak level. In wave 11, total savings go up during the 20s, become constant throughout the 30s and 40s, exhibit a hump during the 50s, and show a significant downward trend between ages 58 and 65. In wave 12, the curve of total savings appears generally stable throughout the working life cycle, with a small up-and-down trend in the early 50s and an upward trend between ages 63 and 65. In wave 13, total savings remain at a constant level between the 20s and early 50s, show a minor hump between ages 54 and 61, and become stable in the 60s, finishing with a small drop.

Total savings remain at a stable level during the 30s and 40s, and show a small humped trend during the 50s. In most cases, pension participants' total savings achieve a peak in the 50s. The trend in the 60s appears to be unclear, when considering the four waves. In sum, life-cycle effects can be seen but they are not pronounced.

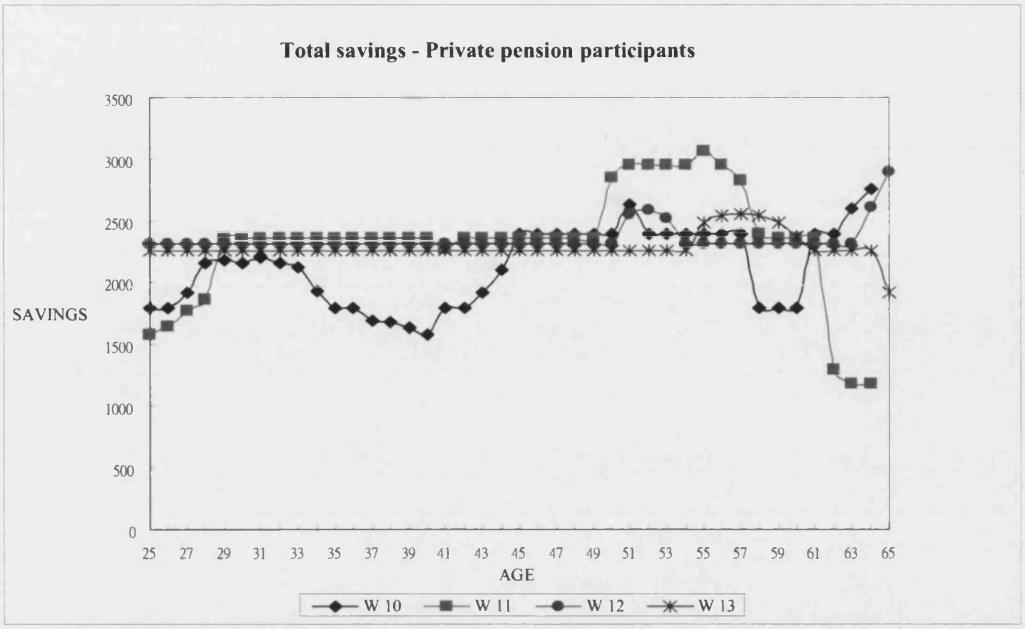

Figure 7-13: The total savings-age profiles of private pension participants

7.4.4.2 Long-term and short-term savings-age profiles

Figure 7-14 shows the long-term savings-age structures of private pension participants. In wave 10, the curve of long-term savings is located at its lowest level at age 25, exhibits a small hump in the 30s, ascends significantly between ages 41 and 47, reaching its peak level, descends slightly in the late 40s, and stabilises at a relatively high level, for the rest of the working life cycle. In wave 11, the profile rises in the 20s, becomes constant during the 30s and early 40s, shows a significant hump between the mid 40s and 50s, and remains stable during the 60s. In wave 12, the long-term savings curve emerges as constant in the period from the 20s to the 50s, with a moderate hump in the early 50s, and ascends gradually during the late 50s and 60s, reaching its peak level. In wave 13, the profile rises between ages 25 and 31 to a relatively high level and subsequently becomes stable for the rest of the working life cycle, with a moderate hump occurring between ages 55 and 61.

Amongst the four long-term savings profiles, humps, as suggested by the conventional life-cycle model, are, in general, observed in between ages 40 and 60: waves 10 and 11 exhibit significant upward trends in this period and reach their peak level, whereas the rises in waves 12 and 13 are relatively mild. The surges in this period point to life-cycle effects, such as income growth and having more dependents. The long-term savings of

the younger cohorts are at their lowest levels, compared with any other time during the working life cycle. However, long-term savings do not fall in the period close to retirement, and this suggests that private pension participants at this stage do not reduce savings for long-term purposes.

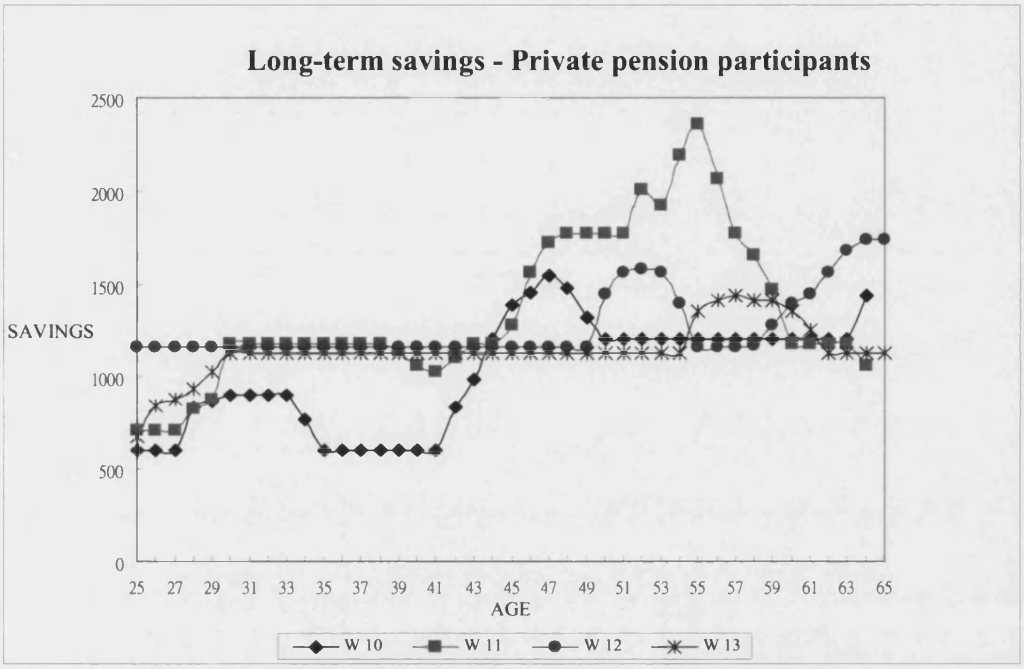

Figure 7-14: The long-term savings-age profiles of private pension participants

Figure 7-15 shows the short-term savings-age structures. In wave 10, the curve of short-term savings appears flat for the whole of the working life cycle, remaining at a relative low level during the 40s and 50s and showing a drop in the 60s. In wave 11, the profile appears as a downward trend throughout the working life cycle: its peak level is at age 29, decreasing in the 30s and 40s, becoming stable in the 50s, and dropping to its lowest level during the 60s. In wave 12, the curve of short-term savings is located at its peak level at age 25, shows significant fluctuations during the 20s and 30s, reaches its lowest level at age 42, slightly rises up thereafter, stabilises through the late 40s and the 50s, and shows mild fluctuations above the previous constant level in the 60s. In wave 13, the profile is situated at its peak at ages 25 and 26, shows a sharp drop in the late 20s, becomes constant during the 30s, descends gradually between ages 38 and 48, reaching its lowest level, and remain constantly at this level for the rest of the working life.

Pension participants' short-term savings show fluctuations during their 30s and 40s, and it is generally observed that the young cohorts save more for the short term than the middle-age groups and those close to retirement. In general, the young cohorts' short-term savings are the highest over the working life cycle, and those who are close to their retirement have the lowest short-term savings. This could be explained in that the young have the strongest precautionary saving motive, and such motive becomes less evident as they age.

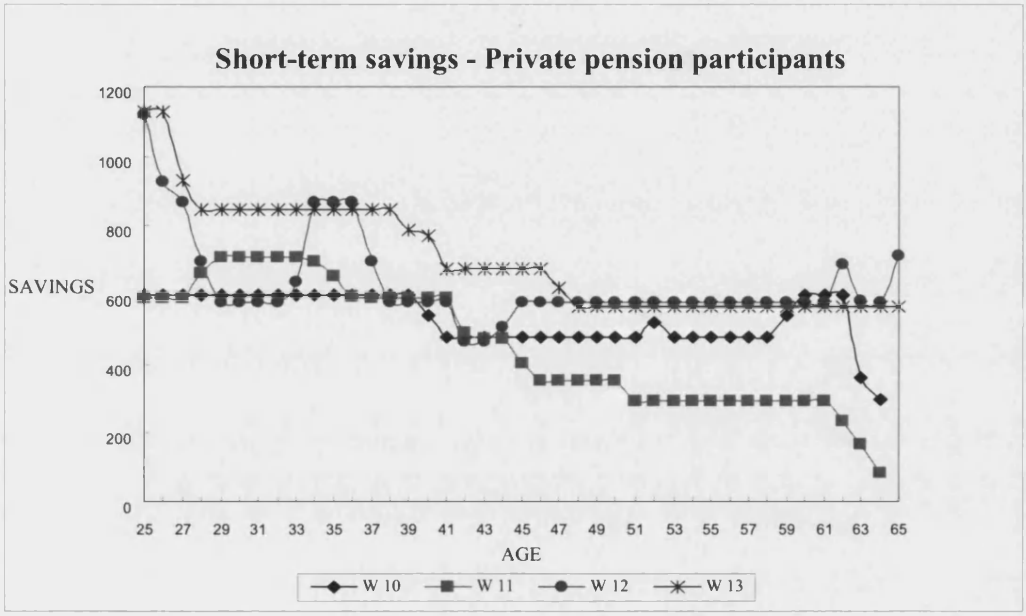

Figure 7-15: The short-term savings-age profiles of private pension participants

7.4.4.3 Summary

Contrasting Figure 7-14 with Figure 7-15 it can be seen that private pension participants save more for the long term than for the short term throughout the working life cycle, except during young age, and this shows that pension participants prefer saving for the long term to saving for the short term. In sum, the long-term savings-age profiles are in support of the conventional life-cycle hypothesis. The downward trends and the fluctuations observed in short-term savings profiles make the effect of high time preference less pronounced. The downward trends can suggest that the preference for short-term savings amongst pension participants decreases with age. This supports the possibility that it is less necessary for them to make precautionary savings when getting closer to the retirement because they have acquired pension wealth to finance their

consumption after that date. Compared with homeowners, pension participants' short-term profiles provide weaker evidence in support of the quasi-hyperbolic consumption model.

Total savings profiles are highly determined by the long-term savings profiles, and the former profiles appear smoother than the latter.

As seen in the figures, disparities are observed amongst the profiles of different waves. This can be explained by: 1) the sample size of pension participants are relatively small; 2) as can be seen in Table 7.5 , 54% of the female households appear only in one wave but only 7.9% of them present in four waves, so individual heterogeneities cannot be controlled properly; and 3) time effects exist.

Table 7.5: The number and percentage of households presenting in four, three, two, and one wave, respectively – Private pension participants

	In four waves		In three waves		In two waves		In one wave		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Pension participants	85	7.9	167	15.6	240	22.4	578	54	1070	100

7.4.5 Employees

7.4.5.1 Total savings-age profile

Figure 7-16 shows the total savings-age structures for employees throughout the working life cycle. In wave 10, the curve of total savings remains stable between ages 25 and 34, descends slightly to its lowest level around the late 30s, exhibits an upward trend afterwards until age 48, becomes stable at a high level during the 50s and 60s, with a small hump at the end of the working life cycle. In wave 11, the profile appears as a smooth hump throughout the working life cycle: it ascends during the 20s, 30s, and 40s, reaching a peak level, becomes stable at this level throughout the 50s, and then descends for the rest of the working life cycle. In wave 12, the curve of total savings climbs upwards during the 20s and 30s, reaching its peak level, and remains stable, at this level, for rest of the working life. In wave 13, the curve of total savings is at its lowest level at age 25, exhibits an up-and-down pattern before the mid 30s, slightly

climbs up thereafter until reaching a peak level, stays constant at this level during the 40s and 50s, and then descends gradually in the 60s.

It is observed amongst the four waves that an upward trend appears in the period between the late 20s and middle age, and this supports the idea that employees' total savings grow with income during this period. Total savings stabilise during the 50s, in general at a peak level, and, as said previously, this was also discovered by some of the empirical literature. Only in waves 11 and 13, are total savings observed to descend during ages close to retirement.

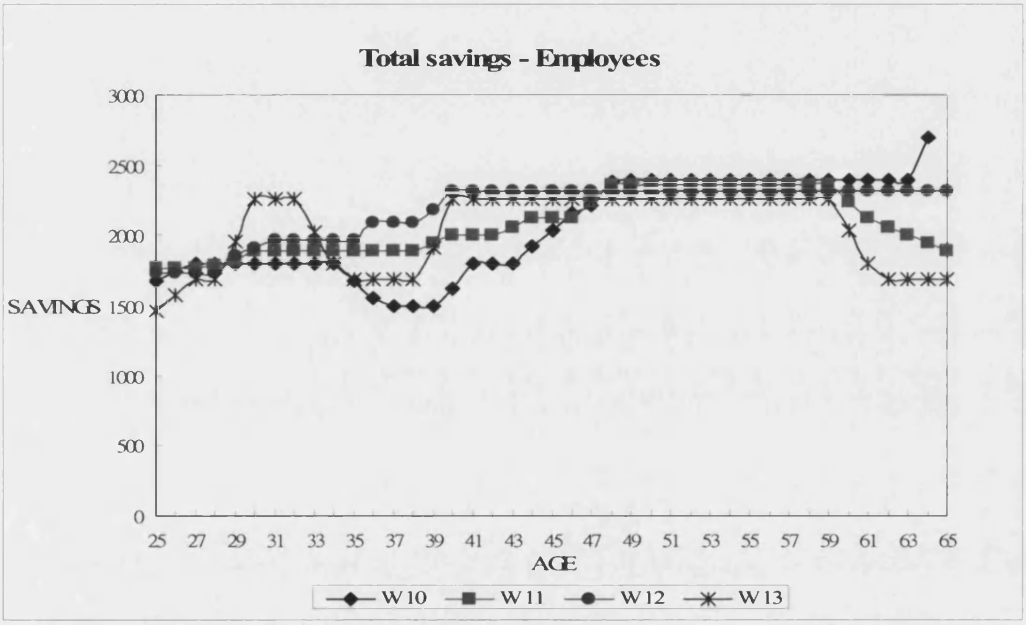

Figure 7-16: The total savings-age profiles of employees

7.4.5.2 Long-term and short-term savings-age profiles

Figure 7-17 shows long-term savings-age structures of employees throughout the working life cycle. In wave 10, the curve of long-term savings appears relatively stable for the 20s and 30s age groups with a small up-and-down movement between ages 30 and 34, ascends significantly during the 40s until reaching a peak level, and becomes constant at this level throughout the 50s and 60s. In wave 11, the profile is at its lowest level at age 25, climbs with large fluctuations during the 30s and 40s until reaching its peak at age 48, and becomes stable at this level throughout the 50s and 60s. In wave 12, the profile exhibits an upward trend for the 20s and 30s age groups with large scale

fluctuations, reaches its maximum at age 41, and stabilises at this level for the remainder of the working life cycle. In wave 13, the curve of long-term savings is located at its lowest level during the 20s, exhibits an upward trend in the 30s and 40s until reaching its peak at age 47, and becomes steady at this level through the 50s and 60s.

Amongst the four profiles, long-term savings are at their lowest levels in the young age period. During the middle-aged phase, they increase to a great extent, reaching a peak in the 40s or early 50s, and then remain steady for the rest of the working life cycle. The upward trends observed amongst the middle-aged cohorts are strongly linked to life-cycle effects, such as income growth and increase in family size. In addition, the long-term savings of the pre-retirement cohorts do not appear to decrease.

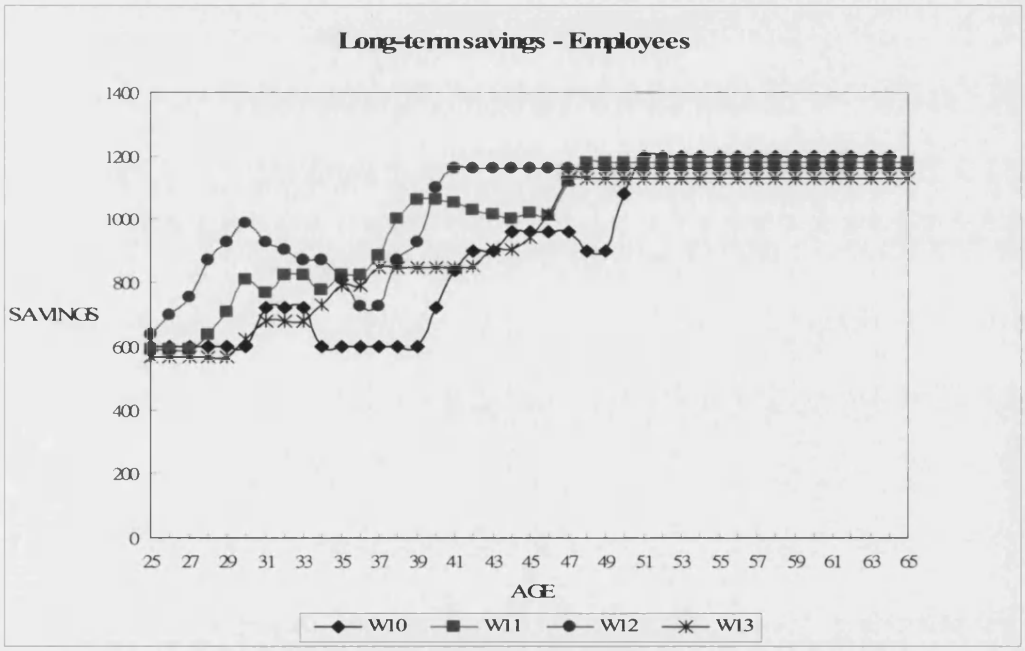

Figure 7-17: The long-term savings-age profiles of employees

Figure 7-18 shows short-term savings-age structures for employees over the working life cycle. In wave 10, the curve of short-term savings appears as constant, at its peak level, throughout the 20s, 30s, 40s, and up until the mid 50s, falls between ages 57 and 60, reaching its lowest level, and becomes stable in the 60s. In wave 11, the profile remains steady at its peak level between age 25 and the mid 50s, and descends considerably for rest of the working life cycle, finishing at its lowest level. In wave 12,

the curve of short-term savings appears steady at a relatively high level before age 60 and shows a sharp drop in the 60s to its lowest level. In wave 13, the profile shows a small surge between ages 25 and 27, stays constantly between ages 27 and 43, climbs to its maximum level. This is followed by a significant drop between ages 43 and 48, becoming steady during the 50s, and descending to a great extent in the 60s, cumulating at its lowest level.

Amongst the four waves, short-term savings appear constant at their peak levels during the young age phase and through to middle-age; they begin to decrease around the mid 50; a downward trend appears in the 60s and the short-term savings of the cohorts close to retirement are the lowest. Three inferences can be made. First, short-term savings are the highest amongst the young and middle-aged cohorts, however, they are not influenced by life-cycle effects, such as, income growth and increase in family size. Second, short-term savings remain at a constant level, indicating that it is likely that employees apply a rule in order to save a regular amount of money for short-term purposes, and employees save only a limited amount money for the short-term future during this period. Third, employees decrease their short-term savings when approaching retirement, and this can be as a result of decreasing income uncertainty that employees have. The first two inferences provide evidence in support of the quasi-hyperbolic consumption model, and the third one is consistent with the prediction of the buffer-stock model.

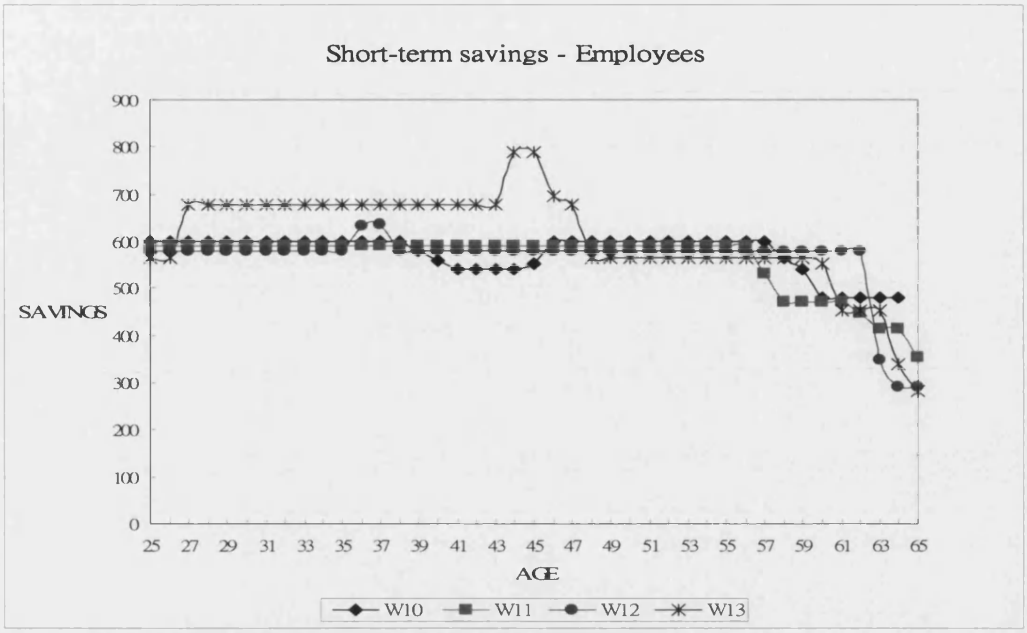

Figure 7-18: The short-term savings-age profiles of employees

7.4.5.3 Summary

Contrasting Figure 7-17 with Figure 7-18 shows that employees save more for the long term than for the short term throughout the working life cycle, as their long-term savings profiles are generally above those for the short term. This suggests that employees prefer saving for the long term to saving for the short term. Employees' total savings profiles show an upward trend in long-term savings during young and middle age and a decline in short-term savings in the 60s, and these are evidence in support of the conventional life-cycle model. Their short-term profiles suggest the influence of high time preference on employees' short-term savings profiles.

Comparing the long-term savings-age profiles of employees' with those of the whole sample allows for the detection of discrepancies, which can be attributed to the self-employeds' savings patterns[104]. In general, the total and long-term savings profiles of employees' are, in general, similar to those of the whole sample, and this suggests that the self-employeds' long-term savings profiles are similar to those of employees. By contrast, short-term savings profiles for employees from young to middle age, appear smoother than those of the whole sample, also, the short-term savings of the whole

[104] As mentioned previously, the self-employeds' saving patterns could not be estimated because of the small sample size of this group.

sample do not consistently appear to descend during the period close to retirement. This suggests that the self-employeds' short-term savings profiles should appear to be more volatile amongst young and middle-aged cohorts, and it is likely that they do not decrease their savings for the short term, as they approach retirement. Two inferences thus can be made: first, some predictions of the conventional life-cycle model can be found in the self-employeds' long-term savings profiles, such as an upward trend during young and middle age; second, the evidence of the influence of high time preference on short-term savings can be found less pronounced amongst the self-employed.

In addition to time effects, the unbalanced dataset (see Table 7.6) can explain the differentials shown in the profiles of different waves.

Table 7.6: The number and percentage of households presenting in four, three, two, and one wave, respectively – Employees

	In four waves		In three waves		In two waves		In one wave		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Employees	423	13.2	584	18.3	786	24.6	1403	43.9	3196	100

7.5 CONCLUSION

This chapter investigated households' intertemporal savings amount with regards to the short-term future and the long-term future, respectively, during the working life cycle; in addition, influences on total savings were also examined. In the whole sample, long-term savings-age profiles and short-term savings-age profiles emerged as different with the long-term savings profiles being well above those of a short-term perspective throughout working life. Life-cycle effects, i.e. income growth and increase in family size during middle-age, are evident in the long-term savings profiles, but are missing in the profiles for short-term savings which, as can be seen, remain stable over most of the working life, except close to retirement. Moreover, the life-cycle effects shown in the long-term savings profiles are evident in the total savings profiles and by contrast, the decreasing trends in the short-term savings profiles close to retirement age, influence the total savings profiles.

Long-term savings profiles showed upward trends from young age through to middle-age and reached a peak around the late 40s or 50s; this was consistent with the standard life-cycle model. However, long-term savings did not show a downward tendency in ages close to retirement, and two reasons for this were proposed: to bequeath to younger generations and/or to accumulate wealth for mortality risk.

By contrast, short-term savings profiles emerged as constant, at peak levels, between age 25 and the mid 50s. This points to the possibility that, from a short-term perspective, households, regardless of income growth in this period, consistently save only small amount of money, as they have a high discount rate with the short-term future. Also, this prevents them from splurging in the short-term future. Moreover, households who practice mental accounting also refrain from putting all the money into accounts for short-term purposes, as they have a higher propensity to consume out of these. Short-term savings profiles showed falls from the mid-50s onwards, and this suggests that households' income risk, especially unemployment risk, is decreasing and that regular expenditure declines as family size decreases. The profiles in this period are within the prediction of the standard/conventional life-cycle model.

The estimates of the profiles for the subgroups give enlightenment to the influence that gender, homeownership, private pension enrolment, and employment status have on the disparities in households' saving behaviour. It was observed amongst males, homeowners, pension participants, and employees that households constantly preferred saving for the long term over the short term throughout the working life cycle.

The key characteristics of the long-term savings profiles for the whole sample were also observed amongst males, homeowners, and employees[105]. By contrast, females' long-term savings profiles are more consistent with the standard life-cycle hypothesis. The long-term savings profiles of private pension participants pointed to the influences of the life-cycle effects in the 40s or 50s, but the patterns during ages close to retirement were unclear. The features of the short-term savings profiles for the whole sample were also detected amongst males, homeowners, and employees. By contrast, a similar

[105] It has been inferred previously that the self-employeds' long-term savings profiles would be similar to those of employees.

inference cannot be drawn from the findings amongst females [106] and pension participants.

To sum up, this study has provided evidence for it being essential to investigate separately household's savings-age profiles regarding two time preferences. Considering the findings in this study, it is concluded that the standard life-cycle model can better explain households' long-term saving profiles and the downwards trends observed during ages close to retirement. In comparison, the behavioural models, which posit the influence of inconsistent time preferences, provide a justification for the short-term savings profiles, which can be seen to remain at a constant level.

[106] This may also be the case for the self-employed.

CHAPTER 8 : SUMMARY AND CONCLUSION

8.1 INTRODUCTION

Deriving from a life-cycle/permanent income hypothesis, the buffer-stock model (Carroll, 1992, 1997) has become a benchmark for explaining consumers' precautionary saving motive and thus has provided valuable insights beyond the traditional life-cycle hypothesis. This model posits that consumers save in this period to buffer against income uncertainty or risk in the next period. Precautionary saving motive emerges when consumers' prudence dominates their impatience. Later, the quasi-hyperbolic life-cycle consumption model (Laibson, 1997, 1998) incorporated a new factor into the buffer-stock model framework, by assuming that consumers have dynamically inconsistent time preference, which is characterised by a quasi-hyperbolic discount function. This model suggests that consumers would gain more utility from consuming a unit of money in the long-term future than in the short-term future. Therefore, sophisticated consumers prefer saving for the long term than for the short term. Inconsistent time preference is considered to occur as a result of consumers' having self-control problems; in order to manage self-control problems, consumers take up precommitment mechanisms to prevent them from splurging in the short term and to save for the long term.

A theoretical anomaly arises as a consequence: the precautionary saving effect, which relates current saving activity to income uncertainty in the next period, may be missing with a hyperbolic consumer, because they are disinclined to save for the next period. This illustrates that hyperbolic consumers' saving decisions regarding saving motives are strongly affected by their inconsistent time preference, whereas under a life-cycle hypothesis, consumers' intertemporal saving decisions emerge mainly as a result of their future needs, which are seen as saving motives, and their time preference is assumed to be consistent over time.

To gain more insights into households' saving behaviour, the empirical studies in this thesis focused largely on examining the implications of the quasi-hyperbolic consumption model, which also included the aforementioned theoretical anomaly, by

investigating the determinants of households' saving motives and those of long-term and short-term decisions.

8.2 SUMMARY

This study examined saving behaviour at the household level by taking into account the influences of psychological factors in an empirical study of economic activities, in order to gain more understanding of the determinants of intertemporal saving decisions.

Chapter 1 gave a background introduction. To begin with, the formation of the concept of consistent time preference in a conventional life-cycle was presented. What followed aimed to highlight to what extent the introduction of some psychological factors has nourished the insights into consumers' saving behaviour. For instance, the introduction of inconsistent time preference suggests that consumers' saving decisions for the short term are the reverse of those which they would make for the long term future. Moreover, the process of how crucial psychological forces take place in a conventional consumption life-cycle model was illustrated. Finally, the main research intuition was set out: to look into consumers' behaviour regarding long-term and short-term perspectives. This was followed by summaries of the important contributions and the outlines of this thesis.

Reviews of theoretical issues and related empirical literature were presented in chapter 2. Of the modern theories of consumption/saving behaviour, the buffer-stock model and the quasi-hyperbolic consumption model share a common proposition: consumers make intertemporal consumption/saving decisions, subject to temporal budget constraints, to maximise expected utility over their life time. However, the latter distinguishes itself by assuming that consumers' time preferences are dynamically inconsistent. The theoretical implications of these two models were summarised and the existing anomalies highlighted. The buffer-stock model suggested the existence of precautionary saving behaviour, which related saving/savings to future income risk. The most important empirical issue was how to choose a proxy indicator for income risk and approaches to measuring it, and other linked factors considered the measurement of savings and econometric estimation methodologies. By and large, empirical studies in

the United Kingdom have confirmed the importance of precautionary saving behaviour. It was also found that the precautionary saving effect does not relate to liquid wealth but to illiquid wealth, which was considered as counterintuitive to the buffer-stock model but can be explained by the quasi-hyperbolic consumption model (Carroll, Dynan, and Krane, 2003). However, empirical studies of the quasi-hyperbolic consumption model are limited. Most of them have been based on structure simulations by using U.S. survey datasets. These calibrations have highlighted that an economy with hyperbolic consumers better fits the observed data than one with exponential consumers. In the United Kingdom, related empirical studies do not exist. These discussions above positioned the main empirical objectives of this study: first, to explore the determinants of households' temporal savings behaviour over a long-term and a short-term planning horizon, respectively; second, to re-examine the precautionary saving effect.

Chapter 3 gave a brief introduction to the data source, sample selection, and elementary data analysis. The datasets used waves 10~13 of the British Household Panel Survey (BHPS). To begin with, descriptions of the survey questions which were considered to be related to this study and were available from the data source were exhibited. This was to specify: 1) the three aspects of temporal saving behaviour – saving motives, saving ratios, and saving amounts, and 2) the factors which were considered to have an impact on saving behaviour. The characteristics of the BHPS provided an advantageous platform for a household-level panel-data analysis for this study. Accordingly, samples for the three empirical analyses in this study were selected, respectively, for panel-data estimation. The selection of the sample was subject to the valid observations of the aforementioned variables. Eventually, the sample included households whose heads were: aged between 25 and 65, employed, and were making savings. Finally, elementary descriptive analyses of the dependent variables and their relationship to the key explanatory variables were presented. In brief, the results showed that a significant portion of households mainly engaged in long-term savings, which was demonstrated by: the frequent response of 'mainly saving for the long term', having a higher long-term savings ratio, and the path of long-term savings amount against the age structure, being seen to exceed that of short-term savings. On the other hand, it emerged that the levels of short-term saving behaviour were consistently low. This provided a preliminary finding of households' favouring saving for the long term than for the short term.

Chapter 4, in accordance with the characteristics of the dependent variables employed in this study, introduced two existing econometric methodologies, which were applied for panel data. One was the random-effect Probit model and the other the random-effect Tobit model. A Probit model was chosen in response to the discrete feature of saving motives, and a Tobit model for the feature of censoring of the saving ratios. Justifications for choosing a random-effect model instead of one of fixed-effect were also provided. Moreover, a seemingly unrelated regression (SUR) model was employed to investigate the determinants of saving motives. This model has the advantage of obtaining cross-sectional estimates by allowing for the correlations between cross-sections. It can be applied in cross-sections with time-series data in that it is assumed that the correlations in the errors capture the households' unobserved heterogeneity and time effects. Yet, contrasting with previous random-effect or a fixed-effect model, a SUR model does not need to impose any assumption on the distribution of the unobserved household heterogeneity. Finally, a non-parametric conditional kernel smooth quantile estimation method was chosen, to estimate the relationship between savings amount and age structure. A non-parametric estimation method plays a role in showing the relationship between the variables, with no need for any specific assumption about the distribution of the error term. This quantile analysis method allows one to look at the median estimates which are less vulnerable to distortion due to extreme observations, whereas mean estimates would easily encounter such a problem in a skewed dataset, which is the case in the dataset of this work. However, the disadvantage of using a cross-sectional estimation method was that the treatment of discriminating cohort effects from age effects could not be carried out, and this was because it would require a long panel to do so.

The empirical frameworks in chapters 5, 6, and 7 were formed in order to gauge the evidence in favour of the quasi-hyperbolic life-cycle consumption model, as well as to re-examine the precautionary saving effect. Chapter 5 explored the determinants of the saving motives of heads of household. The saving motives ranged between mainly saving for the long term and mainly saving for the short term, i.e. two preferences towards saving for the future. The crucial determinants of the tendencies towards these two saving preferences of interest were: the subjectively perceived risk of the households and their engagement in saving commitment mechanisms. Chapter 6 was

concerned with the determinants of the saving ratios for the long-term and short-term horizons. In addition to the impacts from the aforementioned important determinants of saving motives, the influence of a behavioural factor - habit effect – was discussed. The results emphasised that a habitual pattern significantly emerged in households' savings ratios. In contrast to a humped-shape savings-age profile implied by the standard life-cycle model, the feature of inconsistent time preference may cause divergence between the long-term savings-age profile and the short-term savings-age profile, over the life cycle. This forms the foundation of the empirical study presented in chapter 7.

In chapter 5, the determinants of saving motives for the long-term and short-term future of heads of household, were examined. The short-term precautionary saving effect, which was defined as saving for short-term aggregate risk in this study, was not found to be significant at the whole sample level nor in the two subgroups – homeowners and private pension participants. Two explanations were proposed: first, households may have accumulated enough wealth to buffer short-term risk; second, this supported the quasi-hyperbolic consumption model, as this implied that the precautionary saving effect may be missing. In addition, there was another finding that went against the idea of there being a precautionary saving motive, which was that the heads of household with joint income sources were inclined to save for the short term, as discussed earlier. Nevertheless, it was observed at the whole sample level and in the homeowner group that an occupational effect was evident, showing that households in the sectors with unstable income streams and high income variance had stronger short-term saving motives, and this suggested the possibility of precautionary saving behaviour for these groups. However, this was not observed amongst pension participants. At the whole sample level, pension enrolment did not have a significant impact on saving motives, but homeowners were more likely to save mainly for the long term than non-homeowners. The pattern that households, when holding illiquid wealth, exhibited a preference for saving mainly for the long term was consistent with the implications of the quasi-hyperbolic consumption model (Laibson 1998). Housing wealth distinguishes itself from pension wealth in that it can also serve as a type of precautionary savings to buffer uncertainty in the long term. Therefore, the aforementioned finding supports the possibility that housing wealth can be precautionary wealth (Laibson, 1997; Carroll and Samwick, 1998; Carroll, Dynan, and Krane, 2003). Having said this, in the case of homeowners, whether they chose to engage in a private pension scheme or not, had no

effect on their saving motives. This proved to be the same for pension participants in respect of homeownership. Socioeconomic factors had robust impacts on households' saving motives at the whole sample level and in the two subgroups. The results showed that higher education attainment enhanced households' long-term saving motive, and strongly implied that having undertaken higher education played an important role in making people more inclined towards saving for the long term. This was explained by highly-educated households usually being more prudent and more likely to have jobs with higher payment as well as welfare coverage, than low-educated households. Thus, they were less concerned with saving for the short term and more likely to save for the long term. Female heads of households were more likely to save mainly for the short term at the 1% significance level than males, and this implied that females had a more profound short-term saving motive than males. This related to the situation that, in a household, it is usually the female members that are mainly in charge of financial management of a short-term basis. Estimated permanent income was considered as a proxy for a household's wealth level. Households with higher permanent income, or wealth, were more likely to save mainly for the long term, suggesting that households with less wealth concerned themselves more with short-term precautionary savings, than those better off.

The findings in chapter 6 showed the determinants of long-term and short-term savings ratios of the households. Short-term financial expectations did not affect either the short-term or long-term saving ratio, and this finding implied that the precautionary saving effect, from a short-term perspective, was not significant. Households with this year's financial situation better than the previous year, tended to save more for both the long term and the short term. For the subgroups, those in a good current financial situation saved more for the long term, those in a better financial situation than last year saved more for the short term, and those in a financial situation worse than last year save less for the long term. Households whose savings were mainly driven by habit, tended to have a lower short-term saving ratio, than those with a specific reason for saving, whereas the habit effect was not evident on households' long-term saving ratios, in the whole sample or the subgroups. These findings supported the behavioural models in that: firstly, the precautionary saving effect was missing; secondly, households were likely to exercise an internal rule, such as mental accounting, to allocate savings for specific reasons into accounts with a lower propensity to consume. Homeowners'

average short-term saving ratio was lower than that of their counterparts, and this suggested a robust connection between short-term discretionary saving and housing wealth. Two explanations were offered: firstly, housing wealth provided implicit liquidity, so households felt it less necessary to put away money for the short term to buffer short-term uncertainty; secondly, this demonstrated hyperbolic discounting behaviour. Pension enrolment only had an impact on increasing a household's long-term savings ratio. This indicated that there was no evident substitute effect of pension wealth in the accumulation of financial wealth for long-term purposes. Precautionary saving behaviour appeared evident in self-employed households and households in certain occupations. Self-employed households tended to save more for both the long term and the short term than employee households, at the whole sample level and for the subgroups. This verified that the self-employed households had more discretionary savings. Households in the 'sales', 'personal & protective services', and 'craft related' occupations, tended to save more for the short term and less for the long term, than households in the 'plant and machine operative' sector, at the whole sample and the subgroup levels. These occupations were considered to generate unstable income flow and higher income variability; thus, the findings suggested that the households with these jobs had a higher concern with their short-term future, than the long-term future. Socioeconomic factors demonstrated significant impacts on the saving ratios. Female households tended to save less for the long term than male households at the whole sample and for the two subgroups. This strongly related to the fact that females were usually in charge of expenditure management in a household over a short-term horizon. Highly educated households tended to save less for the short term and save more for the long term at the whole sample level and results were the same for the homeowners. This was explained by highly educated households being more prudent with saving for the long term than their counterparts; also, they were likely to be in jobs with good salary and welfare coverage, which mitigated their need of saving for the short term. It was found that as its wealth level increased, the short-term savings ratio of a household decreased, at the whole sample and the subgroup level. It was shown that many life-cycle factors were more influential on households' short-term saving behaviour than on their long-term saving behaviour. Age and household size only affected households' short-term saving ratio. Factors like having young dependents and joint incomes, affected both the long-term and short-term savings ratios.

Chapter 7 investigated households' intertemporal savings amount, with regard to the short-term and the long-term future, respectively, in terms of age structure. This aimed to examine the effect of inconsistent time preference on households' savings-age profile over the life cycle. In the whole sample, the upward trend of total savings was highly determined by long-term savings, whereas the downward tendency close to retirement age, if present, was due to decreasing short-term savings. Total savings fell close to retirement age, and this was also the case with short-term savings, whereas long-term savings remained constant. Males' total savings-age profiles were flattened by both long-term and short-term savings. The reasons for this are as follows: the upward trends that occurred during young age regarding the long-term savings profiles did not appear amongst the aggregate savings profiles, as these effects were disguised by the flat trends observed in the short-term savings profiles. When the short-term and long-term profiles are aggregated, the long-term humps are flattened by the incorporation of the former. Finally, the decreasing trends observed amongst short-term savings profiles during ages close to retirement did not appear in the aggregate savings profiles.

The estimated results showed that females saved more for the short term, than for the long term, before middle age, suggesting that they did not always prefer saving for the long term throughout the working life cycle. The humps observed in the females' total savings profiles were mainly attributed to long-term savings patterns that could be described by the conventional life-cycle model. Females tend to save less for the long term and more for the short term in the last few years of their working lives. The results showed that homeowners, in general, saved more for the long term than for the short term as long-term savings profiles are well above the short-term profiles, throughout the working life cycle. In comparison with the total savings profile of the whole sample, homeowners' profiles were smoother. The life-cycle effects observed amongst homeowners' long-term savings profiles appeared to be concealed in the total-savings profiles. The descending trends displayed in the homeowners' short-term savings profiles did not emerge in the total saving profiles. For pension participants, the total savings profiles were highly determined by the long-term savings profiles, and the former profiles appeared smoother than the latter. In general, downward short-term savings profiles suggested that the preference for short-term savings amongst pension participants decreased with age.

Comparing the savings-age profiles of employees' with those of the whole sample allowed for the detection of discrepancies, which could be attributed to the self-employeds' savings patterns. Employees' total savings profiles showed an upward trend in long-term savings during young and middle age and a decline in short-term savings in the 60s. In general, the total and long-term savings profiles of employees' were similar to those of the whole sample; by contrast, the short-term savings profiles for employees from young to middle age, appeared smoother than those of the whole sample and descended during the period close to retirement. However, the short-term savings of the whole sample did not consistently appear to descend when approaching retirement. This suggested that the self-employeds' short-term savings profile should appear volatile amongst young and middle-aged cohorts, and it was likely that they did not decrease their savings, for the short term, as they approached retirement.

8.3 CONCLUDING REMARKS

Investigating the influence of inconsistent time preference, characterised by a hyperbolic discount function, on households' saving behaviour formed the central intuition of this study. In sum, the findings from the empirical studies of this work emerged as consistent with the theoretical predictions regarding the saving behaviour of hyperbolic consumers. In the United Kingdom, this study was the first to explore such a relevant issue by employing econometric analysis on field panel data from the BHPS.

Questions available from the BHPS, waves 10~13, provided useful information about individuals' subjectively reported main preference of time horizons, regarding a intertemporal saving decision, which could be measured on a monetary scale, i.e. amount of savings. Such information allowed for the formation of two main ways of specifying households' saving behaviour. To begin with, households' saving motives came into view, which varied between saving mainly for the long-term future, saving mainly for short-term purposes, and saving for both the long and the short term, equally. Saving motives, here, represented individual's subjective planning time horizons for a saving decision and gave an indication for how long households were willing to delay consumption and hence pinned down their preferences. Being able to locate time

preference regarding an intertemporal saving decision, was one contribution of this study. Secondly, compared with 'the motive' which was a psychologically oriented concept, an economic concept – saving amount - was later taken into account, which could be measured monetarily.

The concept of *savings* in this study referred to households' discretionary savings in financial accounts. The savings were limited to households' saving acts which took place only in that period, and were considered to be appropriate under the definitions of savings in this study. The effects of intertemporal time preferences occurred before every saving act was made in each period. Moreover, time preference was considered to be dynamically inconsistent, e.g. from this moment, a time two years hence could be seen as a long-term horizon, whereas one year in the future it was considered to be short-term. Identifying a household's time preference for a saving act was restricted to the period when the saving acts occurred, rather than from total assets accumulated. If accumulated assets were used, a complex set of intertemporal decisions from the past would have to be included, for which there was no available information

Contrasting the theoretical implications of the buffer-stock model and the quasi-hyperbolic consumption model, the effects of inconsistent time preference related to three hypotheses: 1) the precautionary saving effect was missing; 2) saving for the long term was preferred to saving for the short term; 3) long-term saving preference was positively associated with consumers' tendency towards holding illiquid wealth, e.g. housing wealth and/or self-imposed commitment to saving, such as joining in a private pension scheme. These hypotheses set out the empirical studies in chapters 5, 6, and 7.

In sum, this study found that when the precautionary saving effect was conceptualised as the relationship between short-term saving behaviour and future uncertainty, it was missing. This was supported by the results that households' financial expectations did not have an influence on their short-term saving behaviour.

Holding housing wealth or joining in a private pension scheme were influential on saving behaviour. The empirical results in this study showed that homeowners were inclined towards saving mainly for the long term and averse to saving mainly for the short term, when they were making discretionary savings. This reinforced the possibility

that households in possession of illiquid wealth tended to show a weaker preference in saving for the short term. In addition, homeowners tended to save less for the short term than non-homeowners, but saved indifferently for the long term to non-homeowners. This strongly supported the quasi-hyperbolic consumption model in that such households tended to possess short-term savings at lower levels and meanwhile engaged in illiquid housing wealth. Whilst the effect of pension enrolment was insignificant on saving motives, the results showed that pension participants tended to save more for the long term. This suggested that pension participants managed to make more discretionary saving for the long tem than their counterparts who did not precommit themselves to saving for retirement. This confirmed the effect of engaging in an external commitment mechanism on long-term savings, and did not support the crowd-out effect of pension wealth on discretionary saving, whilst the standard life-cycle hypothesis would suggest such a crowd-out effect.

Regarding the savings-age profiles, the results favoured the behavioural models. Long-term savings profiles showed upward trends from young age through to middle-age and reached a peak around the late 40s or 50s; this was consistent with the standard life-cycle hypothesis. However, long-term savings did not show a downward tendency in ages close to retirement, and two reasons for this were proposed: to bequeath to younger generations and/or to accumulate wealth for mortality risk. By contrast, short-term savings profiles emerged as constant, at peak levels, between age 25 and the mid 50s. This pointed to the possibility that, from a short-term perspective, households, regardless of income growth in this period, consistently save only a small amount of money. This could be explained because: 1) they had a high discount rate with the short-term future; or 2) households practiced mental accounting and hence refrained from putting too much money into accounts for short-term purposes, for which they had a higher propensity to consume. Short-term savings profiles showed falls from the mid-50s onwards, and this suggested that households' income risk, especially unemployment risk was decreasing and that regular expenditure declined as family size decreased. In sum, it was concluded that the standard life-cycle model could better explain households' long-term saving profiles than short-term saving profiles. However, the behavioural models, which posit the influence of inconsistent time preferences, provided a justification for the short-term savings profiles.

Socioeconomic factors – the attainment of higher education and gender – played robust roles in determining households' saving behaviour. Compared with males, females' long-term savings profiles were more consistent with the standard life-cycle hypothesis, displaying as a hump shape. Males' short-term savings profiles were more in line with the prediction of the behavioural models, whereas females' profiles exhibited fluctuations. The results that females were more likely to save mainly for the short term and that they tended to save less for the long term than males, suggested that the short-term precautionary motive may be more profound in females than in males, and they were less impatient than the latter. Those who have attained higher education were inclined to save mainly for the long term and tended to save less for the short term than they did for long-term purposes.

A well-established habit had an impact on a household's saving behaviour, and this was especially a focus in the domain of Behavioural Economics (Katona, 1980). A continuous habit could be the resistance to changes in human nature, suggesting an endowment effect. Such a habit effect on saving behaviour may take place so as to keep consumption expenditure below a certain level (Wärneryd, 1999); alternatively, it could play the role as an internal rule of thumb for precommitments (Shefrin and Thaler, 1988). The results in this study showed that households who saved mainly as the result of a habit tended to save less for the short term, but saved indifferently for the long term, when compared with their counterparts. This suggested that, if a habit effect played the role as an internal force in helping households, either to control expenditure or to save, it worked well for saving more for the long term but worked poorly in the case of short term saving. This could be explained by households' being biased towards instant gratification rather than saving for the short term.

To conclude, households' intertemporal saving behaviour, regarding the long-term future, displayed itself to be inconsistent with that for the short term. This could be seen from the investigation of the influences of various factors on households' saving behaviour, which included: future uncertainty or risk, possession of illiquid wealth, exercising an internal rule or engaging in an external mechanism to make savings, and other socioeconomic and demographic factors. In brief, the findings provided valuable empirical evidence in support of the quasi-hyperbolic life-cycle consumption model and the behavioural life-cycle model.

8.4 IMPLICATIONS AND FUTURE EXTENTION

This study found that households did not save more with respect to risk in the short-term future, and holding housing wealth further discouraged them from accumulating short-term savings. Assuming that the housing market remains stable, a question emerges: how do households finance their short-term income fluctuations? The concept of 'Debt Puzzle' was firstly proposed by Laibson, Repetto, and Tobacman (2000), regarding the phenomenon of households holding high credit card debts and high illiquid wealth at the same time, which suggested that they tended to borrow via credit cards to finance their short-term consumption. In the United Kingdom, much attention of policy analysts has been paid to the fact that the amount of unsecured debt has been surging in recent years. However, to the knowledge of this researcher, the impact that inconsistent time preference could have on the accumulation of unsecured debt, has not been investigated in this country. Therefore, it is worthwhile to examine whether or not British households rely largely on unsecured debt to finance their instant gratification. For such credit borrowers or for those homeowners who are still on a mortgage, their having lower liquid savings for short-term purposes may make them more vulnerable to changes in the monetary policy, which would be of note to policy analysts.

This thesis found that joining in a private pension schemes was related to households' higher discretionary savings for the long term. This was consistent with what Katona (1965) stated: wealth did not necessarily reduce saving motives, and social security and private pension wealth may even increase the desire to save because being closer to one's goal represented a psychological force that enhanced motivation, whereas motivation was weakened when it appeared impossible or very difficult to reach such a goal. A further extension of this could research the level of effectiveness, in a quantitative sense, of engaging in a private pension scheme or any other saving mechanism in enhancing households' discretionary saving for the long term. This would lead to further useful insights for policymakers.

The influences of gender and the educational attainment displayed themselves as robust on households' saving preferences and amount of savings made. Compared with males, females had a stronger short-term saving preference, but they had lower savings for the

long term. Lowly educated households had a weaker preference for long-term savings and saved less for the long term. Therefore, a mandatory scheme of saving for retirement may be more necessary for females than males and for the lowly educated than the highly educated. An inference can be drawn: understanding the time preferences of the saving behaviour of different socioeconomic cohorts, provides useful information for evaluating the efficacy of a policy tool which is employed to enhance savings, e.g. a mandatory saving scheme.

It can be tracked back to 1834 when John Rae discussed the sociological and psychological determinants of intertemporal choices to explain the differences of national wealth across nations. Analogously, the concept of inconsistent time preferences could play a part in explaining the variations in different nations' patterns of asset and unsecured debt accumulation, in a comparative study between countries. To successfully carry out such further research would require comprehensive field data which would need to collect consumers' saving preferences in terms of time horizon as well as information on their asset portfolios and unsecured debt holdings.

APPENDICES

SECTION A: DUMMY INDICATORS

Table A.1 : Education dummy indicator

Code	New education indicator	Old (old code) education indicator
1	Higher than college	Higher degree (1)
2	College	First degree (2)
3	Some college	Teaching QF (3); Other higher QF (4); Nursing QF (5)
4	A levels	GCE A levels (6)
5	Less than A levels	Others (7 and above)

Table A.2: Occupation dummy indicator

Code	New occupation indicator	Old occupation indicator
1	Managers & administrators (1)	Employers, large; Managers, large; Employers, small; Managers, small; Farmers--employers
2	Professional (2)	Professional, self-employed; Professional, employee
3	Associate professional & technical (3)	Junior non-manual; Unskilled manual worker
4	Clerical & secretarial (4)	Intermediate non-manual, work; Intermediate non-manual, foreman
5	Craft related (5)	Skilled manual workers; Semi-skilled manual; Foreman, manual
6	Personal & protective services (6)	Personal service worker; Members of armed for
7	Sales (7)	Own account workers
8	Plants & machine operatives (8)	Agricultural workers; Farmers—own account

Table A.3: Residential area dummy indicator

Code	New area indicator	Old (old code) area indicator
1	Greater London (1)	Inner London (1); Outer London (2)
2	South East (2)	Rest of South East (3)
3	South West (3)	South West (4)
4	East (4)	East Anglia (5); East midlands (6)
5	West Midlands (5)	West midlands conurbation (7); Rest of west Midland (8)
6	Greater Manchester (6)	Great Manchester (9)
7	North West (7)	Merseyside (10); Rest of North West (11)
8	Yorkshire & Humberside (8)	South Yorkshire (12); West Yorkshire (13); Rest of York & Humberside (14)
9	Tyne & Wear (9)	Tyne & Wear (15); Rest of North (16)
10	Wales (10)	Wales (17)
11	Scotland (11)	Scotland (18)
12	Northern Ireland (12)	Northern Ireland (19)

SECTION B: PROGRAMMING CODE OF THE KERNEL-SMOOTHED CONDITIONAL QUANTILE ESTIMATION METHOD

```
@ To get variables, age and savings@
output file = quantitle.out reset;
load yy[1705,2]= D:\Gauss\Savingratio\agesaving.dat;

"Do you want to search for CV bandwidth?";
"Type 0 for NO";
switch1=con(1,1);
if switch1==0; "what bandwidth do you want"; bw=con(1,1);
"you have chosen BW=";; bw; endif;

nst=40;
"Number of bins:";; nst;

qts=.25|.5|.75;
"Quantiles are:";; qts';

@transform and standardise data@
zz=sortc(yy,2);
clear yy;

yoo=zz[.,2];
xo=zz[.,1];
n=rows(xo);

"Number of data points used:";; n;
maxage=maxc(xo);
minage=minc(xo);
ages=maxage-minage+1;

clear zz;

format /m1 /rd 10,2;
"Min Dependent:";;yoo[1,.];
"Max Dependent:";; yoo[n,.];
"Age of Max Dependent holder:";; xo[n,.];
"Median Dependent:";; yoo[trunc(n/2),.];
save yoo;

clear yoo;


@ create cdfs by age@
```

```
y=seqa(1,1,n);
maxy=n+1;
miny=0;
step=(maxy-miny)/(nst-1);
rngy=seqa(miny,step,nst);
z=zeros(nst,ages);
agecount=zeros(ages,1);


i=0;
do until i==ages;
j=i+minage;
i=i+1;
if sumc(xo .eq j)==0; "No one age:";;j;
if j==maxage; break; endif;
if j .lt maxage; j=j+1; i=i+1; continue; endif;
endif;
if sumc(xo .eq j)==1; "One person age:";; j; endif;
y3=selif(y,(xo .eq j));
agecount[i,.]=rows(y3);
tm1=y3 .le rngy';
z[.,i]=sumc(tm1);
endo;

format /m1 /rd 14,2 ;
"Level of Ind var count";
seqa(minage,1,ages)~agecount;

agec1=(agecount .eq 0)+agecount;
z=z./agec1';
agec2=(agec1 .eq 1)+agec1;
div=1/(agec2-1);
zsdif=(z .lt 1).*(z.*(div'));
zbdif=(z .lt 0).*(z.*(div')-(div'));
zs=z+zsdif;
zb=z+zbdif;

save z, agecount, rngy, xo, zsdif, zbdif, zs, zb;

@ end create cdfs by age @


load xo, z, agecount, yoo, rngy;
m=seqa(minage,1,ages);
bwsave=zeros(ages,3);


@ calculate qhats @
```

```
qhatm=zeros(rows(agecount),rows(qts));

i=0;
do until i==rows(qts);
qt=qts[i+1,.];

lbt=sumc(z .lt qt);
t1=(lbt .eq 0)+(lbt .eq rows(z));
lb=(t1 .eq 0).*lbt + (t1 .ne 0)*trunc(rows(z)/2);
klb=diag(submat(z,lb,0));
kub=diag(submat(z,(lb+1),0));
qlb=rngy[lb,.];
qub=rngy[(lb+1),.];
kr=kub-klb;
kr=(t1 .eq 0).*kr + .1*(t1 .eq 1);
qhat=((qt-klb).*qub+(kub-qt).*qlb)./kr;
qhatm[.,i+1]=qhat;
i=i+1;
endo;

qhat=qhatm[.,1];

format 10,6;

proc loss(a1);
@ This proc calcs values for loss function @
@   a1 is bandwidth  @

  local j, kr, klb, kub, kscdf, kscdfs, kscdfss, kscdfsb, lb, loss, m,
   n1, n2, n3, ncol, qlb, qub, qk, qks, qkb, qtv, sw3, wd, wt1, wt2,
   wt3, wts, none, vect, wtemp, tmat, wtsd,
   zlb, zub, zk, loss1,y1,y2, rz, ii, ni, route1, route2;

@ create triangular kernel weights @
wts=zeros(ages,ages); @ cols are weights for each age @
m=seqa(minage,1,ages);


j=minage;
do until j==maxage+1;
wt1=1 - (4/(a1^2))*((m-j)^2);
wt2=wt1.*(wt1 .gt 0);
wts[.,j-(minage-1)]=wt2;
j=j+1;
endo;

wd=diag(wts).*(agecount .gt 0);
wt3=wts.*agecount;
sw3=sumc(wt3);
wts=wt3./sw3';
```

```
wtsd=diag(wts);

@ end create triangular kernel weights @
rz=rows(z);

@ calc kernel smoothed quantiles @

kscdfs=z*wts;
lbt=sumc(kscdfs .lt (qt+10^(-10)));
t1=(lbt .eq 0)+(lbt .eq rz);
lb=(t1 .eq 0).*lbt + (t1 .ne 0)*trunc(rz/2);
klb=diag(submat(kscdfs,lb,0));
kub=diag(submat(kscdfs,(lb+1),0));
qlb=rngy[lb,.];
qub=rngy[(lb+1),.];
kr=kub-klb;
kr=(t1 .eq 0).*kr + .1*(t1 .eq 1);
qk=((qt-klb).*qub+(kub-qt).*qlb)./kr;
clear z;

load zsdif,zs;
kscdfss=((kscdfs+zsdif.*wtsd').*sw3'-zs.*wd')./(sw3-wd)';
lbt=sumc(kscdfss .lt (qt+10^(-10)));
t1=(lbt .eq 0)+(lbt .eq rz);
lb=(t1 .eq 0).*lbt + (t1 .ne 0)*trunc(rz/2);
klb=diag(submat(kscdfss,lb,0));
kub=diag(submat(kscdfss,(lb+1),0));
clear kscdfss;
qlb=rngy[lb,.];
qub=rngy[(lb+1),.];
kr=kub-klb;
kr=(t1 .eq 0).*kr + .1*(t1 .eq 1);
qks=((qt-klb).*qub+(kub-qt).*qlb)./kr;
clear zsdif,zs;

load zbdif,zb;
kscdfsb=((kscdfs+zbdif.*wtsd').*sw3'-zb.*wd')./(sw3-wd)';
lbt=sumc(kscdfsb .lt (qt+10^(-10)));
t1=(lbt .eq 0)+(lbt .eq rz);
lb=(t1 .eq 0).*lbt + (t1 .ne 0)*trunc(rz/2);
klb=diag(submat(kscdfsb,lb,0));
kub=diag(submat(kscdfsb,(lb+1),0));
clear kscdfsb,kscdfs,zbdif;
qlb=rngy[lb,.];
qub=rngy[(lb+1),.];
kr=kub-klb;
kr=(t1 .eq 0).*kr + .1*(t1 .eq 1);
qkb=((qt-klb).*qub+(kub-qt).*qlb)./kr;
clear zbdif,zb;
```

```
@ end calc kernel smoothed quantiles @

lb=sumc(rngy .lt qk');
klb=rngy[lb,.];
kub=rngy[lb+1,.];
load z;
zlb=diag(submat(z,lb,0));
zub=diag(submat(z,lb+1,0));
kr=kub-klb;
zk=(zub.*(qk-klb)+zlb.*(kub-qk))./kr;
qtv=qt*ones(rows(zk),1);
n1=(minc(qtv'|zk')).*agecount;
n3=(1-maxc(qtv'|zk')).*agecount;
n2=agecount-n1-n3;

loss1=(1-qt)*(n1.*(qkb-qhat))+qt*(n3.*(qhat-qks))
   +(qk .gt qhat).*n2.*(qt*qhat+(1-qt)*qkb-(qhat+qk)/2)
   +(qk .lt qhat).*n2.*((qhat+qk)/2-(1-qt)*qhat-qt*qks);
loss=sumc(loss1);

retp(loss);

endp;

route3:

if switch1==0; goto route4; endif;
"If you do not wish to search for optimal bandwidth, type 0";

test1=con(1,1);
"Starting bandwidth";; stbase = con(1,1);
"Size of step";; step=con(1,1);

"Number of steps";; nstep=40 @con(1,1)@;

"Quantile Loss";
"BW  Total";

i=1;
do until i .gt nstep;
j=stbase+(i-1)*step;

jk=0;
do until jk==rows(qts);
qt=qts[jk+1,1]; qhat=qhatm[.,jk+1];
if jk==0; lossm=loss(j); else; lossm=lossm~loss(j); endif;
jk=jk+1;
endo;

j;; sumc(lossm');
```

```
i=i+1;

endo;
wait;

goto route3;


route4:

@ ************** SET UP PLOTS ******************************** @

"If you want to create a matrix of quantile values - type 1;
if not, type anything else to proceed  ";;
no=con(1,1);
if no==0; goto route5; endif;

clear z;

clear jb1, jb2, jb3, jb4;

proc plotmat(a1);
@ This proc sets up matrix to be plotted @
@   a1 is bandwidth  @

  local j, kr, klb, kub, kscdf, kscdfs, kscdfss, kscdfsb, lb, loss, m,
   n1, n2, n3, ncol, qlb, qub, qp1, qk, qks, qkb, qtv, sw3, wd, wt1, wt2,
   wt3, wts, none, vect, wtemp, tmat, wtsd,
   zlb, zub, zk, loss1,y1,y2, rz, ii, ni, route1, route2,
   qk1,qk2,qk3;

@ create triangular kernel weights @

load z;

wts=zeros(ages,ages); @ cols are weights for each age @
m=seqa(minage,1,ages);

j=minage;
do until j==maxage+1;
wt1=1 - (4/(a1^2))*((m-j)^2);
wt2=wt1.*(wt1 .gt 0);
wts[.,j-(minage-1)]=wt2;
j=j+1;
endo;

wd=diag(wts).*(agecount .gt 0);
wt3=wts.*agecount;
sw3=sumc(wt3);
```

```
wts=wt3./sw3';



@ end create kernel weights @
rz=rows(z);

@ calc kernel smoothed quantiles @

kscdfs=z*wts;
jb4=z;

lbt=sumc(kscdfs .lt (qt+10^(-10)));
t1=(lbt .eq 0)+(lbt .eq rz);
lb=(t1 .eq 0).*lbt + (t1 .ne 0)*trunc(rz/2);
klb=diag(submat(kscdfs,lb,0));
kub=diag(submat(kscdfs,(lb+1),0));
qlb=rngy[lb,.];
qub=rngy[(lb+1),.];
kr=kub-klb;
kr=(t1 .eq 0).*kr + .1*(t1 .eq 1);
qk=((qt-klb).*qub+(kub-qt).*qlb)./kr;
jb3=qk;

qk1=trunc(qk); qk2=1+qk1; qk3=qk-qk1;
rows(yoo) cols(yoo);
rows(qk3) cols(qk3);
jb1=qk1;
jb2=qk2;

qp1=qk3.*yoo[qk2,.]+(1-qk3).*yoo[qk1,.];

clear z;
retp(qp1);
endp;

ftrip=1;

route6:

if switch1 .ne 0;
"Set bandwidth  ";; bw=con(1,1);
"You have chosen BW = ";; bw;
endif;

i=1;
do until i .gt rows(qts);
qt=qts[i,.];
if (i==1) .and (ftrip==1); ksqtout=plotmat(bw);
  else; ksqtout=ksqtout~plotmat(bw); endif;
```

```
i=i+1;
endo;


"Do you want to add values for another bandwidth to the output?
Type 0 for no; anything else to continue";;
 no=0 @con(1,1)@;
if no==0; goto route7; else; ftrip=2; goto route6; endif;

route7:
ksqtout=seqa(minage,1,ages)~ksqtout;

format /m1 /rd 8,0;
ksqtout;


route5:

closeall;


output off;


saveall ratiosecond;
```

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